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The Engineer

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PUBLIC NOTICES

TENDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS, before 11 a.m. on Monday, 24th October, 1921, for the SUPPLY of ELECTRIC LAMPS.

Forms of Tender, &c., may be obtained on application to the CONTROLLER OF SUPPLIES, H.M. Office of Works, &c., King Charles-street, Westminster, London, S.W. 1. 6406

Civil Engineers Required by the GOVERNMENT OF THE GOLD COAST for service as EXECUTIVE ENGINEERS in the Public Works Department, for two tours, each of 12-18 months, with prospect of further employment. Salary £480, rising by annual increments of £30 to £720 a year, and thereafter by £40 to £920 a year, with an outfit allowance on first appointment of £60. Married men will also be paid, during 1921, a special allowance at the rate of £60 a year, which may be continued. Free single quarters and first-class passages. Liberal leave in England on full salary.

Candidates, under 35, preferably single, who have had practical and general experience as civil engineers on roads, buildings, and other public works, should apply at once in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Gold Coast 11,113. 6423

Portsmouth Municipal College.

APPLICATIONS are INVITED for the APPOINTMENT of a WORKSHOP INSTRUCTOR, fully qualified in both Wood and Metal Work. Candidates should hold diplomas of the City and Guilds of London Institute, and preference will be given to one with trade experience. Salary according to qualifications and experience.—Further particulars and forms of application may be obtained from the SECRETARY, to whom applications should be returned at once, accompanied by copies only of not more than three recent testimonials. 6438

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
RUSTING OF MILK CHURNS.

The Proprietors of British Letters PATENT No. 11,821 of 1907 are PREPARED to SELL the PATENT or to LICENSE British manufacturers to work under it. It relates to an improved method of preventing rusting in tinned iron vessels, particularly those used for storing and transporting milk.

Address: BOULT, WADE and TENNANT, 111/112, Hatton-garden, London, E.C. 1. 6381

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
GEAR CUTTING MACHINES.

The Proprietors of British Letters PATENT No. 106,520 are PREPARED to SELL the PATENT or to LICENSE British manufacturers to work under it. It relates to machines for cutting gears or pinions of the curved herring-bone type and particularly to the mechanism controlling the relative motions of cutter and blank.

Address: BOULT, WADE and TENNANT, 111 and 112, Hatton-garden, London, E.C. 1. 6382

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
PRESS TOOLS.

The Proprietor of British Letters PATENT No. 27,333 of 1911 is PREPARED to SELL the PATENT or to LICENSE British manufacturers to work under it. It relates to machines for drawing and shaping hollow metal vessels which are tapered at both ends like barrels.

Address: BOULT, WADE and TENNANT, 111 and 112, Hatton-garden, London, E.C. 1. 6383

The Proprietors of Letters Patent No. 2016/1913, relating to MACHINES FOR SWINGLING OR FOR BREAKING AND SWINGLING FLAX, DESIRE to DISPOSE of their PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Inquiries to be addressed to

CRUIKSHANK and FAIRWEATHER, 65-66, Chancery-lane, London, W.C. 2. 6402

The Proprietor of Letters Patent No. 102,143, relating to "CONTROL SWITCHES FOR ELECTRICALLY CONTROLLED APPARATUS FOR MEASURING LIQUIDS,"

and No. 102,236, relating to "LOCKING DEVICES FOR FLUID MEASURING APPARATUS,"

DESIRES to DISPOSE of his PATENTS or to grant LICENCES to interested parties on reasonable terms with a view to the adequate working of the patents in this country.—Inquiries to be addressed to

CRUIKSHANK and FAIRWEATHER, 65-66, Chancery-lane, London, W.C. 2. 6433

Borough of Portsmouth.
MAIN DRAINAGE.
CONTRACT NO. 4.
TO CENTRIFUGAL PUMP AND ELECTRICAL MANUFACTURERS.

The Corporation of Portsmouth is prepared to receive TENDERS for the CONSTRUCTION, DELIVERY, and ERECTION of FOUR CENTRIFUGAL PUMPS direct coupled to 2-phase A.C. MOTORS, a SLUDGE PUMP and MOTOR, and various small MOTORS, SWITCHBOARDS, CABLES, LIGHTING and other APPARATUS, in accordance with drawings, general conditions, and specification, copies of which may be obtained at the office of the Engineer, Mr. G. Midgley Taylor, of John Taylor and Sons, 36, Victoria-street, S.W. 1, upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

These documents will only be issued to bona fide makers of centrifugal pumps and electrical manufacturers.

Sealed Tenders, endorsed "Main Drainage, Contract No. 4," addressed to the Town Clerk, are to be delivered at his office at or before 9 a.m. on Friday, 18th November, 1921.

The Corporation does not bind itself to accept the lowest or any Tender.

F. J. SPARKS, Town Clerk.

Town Clerk's Office, The Town Hall, Portsmouth, 5th October, 1921. 6437

PUBLIC NOTICES

County Borough of Wallasey.
SEACOMBE FERRY IMPROVEMENTS.

The Corporation of Wallasey invite TENDERS for the CARRYING OUT of that portion of the above work denominated work "B" NEW FLOATING ROADWAY, and work "C" CCT for NEW FLOATING ROADWAY, and works in connection therewith in accordance with the detailed plans and specification of Messrs. Wilton and Bell, Consulting Civil Engineers, Westminster Chambers, 1, Crosshall-street, Liverpool, at whose office copies of the specification and drawings may be seen.

Contractors desiring to obtain copies of plans and specification and schedule of quantities may do so on payment of a fee of £2 2s. for each work, or of £3 3s. for the two works, which fees will not be returnable.

Tenders, on the form of Tender provided, must be delivered to the undersigned in a sealed envelope, endorsed "Tender for Seacombe Ferry Improvements, Works "B" and/or "C," not later than Twelve Noon, Saturday, November 5th, 1921.

GEO. LIVSEY, Town Clerk.

Town Hall, Wallasey, 7th October, 1921. 6357

City of Leeds.
WATERWORKS DEPARTMENT.

The Waterworks Committee of the Leeds Corporation invite TENDERS for the DESIGN and CONSTRUCTION of an ELEVATED WATER-TIGHT REINFORCED CONCRETE TANK and PUMP-HOUSE at Moortown, Leeds.

Forms of Tender, conditions of contract, and specifications may be obtained from the Waterworks Engineer, Leeds, on payment of a fee of £1, which will be returned on receipt of a bona fide Tender for the work.

Tenders, enclosed in a sealed envelope, endorsed "Tender for Moortown Tank," must be addressed to the Chairman of the Waterworks Committee, Town Clerk's Office, Park-square, Leeds, and delivered not later than 10 a.m. on the 14th of November, 1921.

The Committee does not bind itself to accept the lowest or any Tender.

CHARLES G. HENZELL, M. Inst. C.E., Waterworks Engineer.

26, Great George-street, Leeds, 1st October, 1921. 6321

Siamese State Railways.

TENDERS are INVITED for the SUPPLY of 20 BOGIE RAIL TRUCKS.

Specifications and drawings may be obtained against payment of £1, from Messrs. C. P. Sandberg, 40, Grosvenor-gardens, London, S.W. 1.

Sealed Tenders, with the inscription "Tender for 20 Bogie Rail Trucks, 2484," must be forwarded to the undersigned, at whose office in the City of Bangkok, Siam they will be received up to 2 p.m. on the 16th January, 1922, at which place and hour the Tenders will be publicly opened and read.

Right is reserved to reject any or all Tenders and to accept any Tender which in the opinion of the undersigned is to the best interests of the Siam State Railways.

PURACHATRA, Commissioner General of Siam State Railways.

Department of State Railways, Bangkok, September, 1921. 6401

The Ministry of Public Works, Egyptian Government, are calling for TENDERS for the SUPPLY of PUMPING PLANT and MACHINERY to be erected by the contractors at Atf.

The plant to include 4 Diesel or semi-Diesel engines, each directly coupled to a turbine or centrifugal pump, with all necessary pipes, &c.

Conditions of Tender and specification, price 10s., can be obtained from THE INSPECTING ENGINEER, Egyptian and Sudan Governments, Queen Anne's Chambers, Westminster, S.W. 1. 6400

PUBLIC NOTICES

Borough of Newark.
REFUSE DISPOSAL AND SALVAGE WORKS.

The Cleansing Committee are prepared to receive TENDERS from manufacturers for the following PLANT and MACHINERY:—

1. VERTICAL BOILER.
2. 50 B.H.P. ENGINE.
3. SALVAGE PLANT.
4. (a) PULVERISER.
   (b) ELEVATOR.
5. INCINERATOR.
6. SKIP ELEVATOR AND MECHANICAL FEEDER (provisional).

Full particulars and plan of proposed works may be obtained on application to the Borough Surveyor, Mr. J. W. Hipwood, A.M.I.C.E., Town Hall, Newark, on the deposit of £2 2s., being made and which will be returned on receipt of a bona fide Tender.

Suitably endorsed and sealed Tenders to be delivered to my office not later than Noon on Monday, 31st October, 1921.

The lowest or any Tender will not necessarily be accepted.

HUGH TALLENTS, Town Clerk.

Town Clerk's Office, Newark-on-Trent, 11th October, 1921. 6410

East Indian Railway.

The East Indian Railway Company is prepared to receive TENDERS for the SUPPLY and DELIVERY of:—

(1) BRUSHES.
(2) HAIR BELTING.

as per specifications to be seen at the Company's offices.

Tenders are to be sent to the undersigned, marked "Tender for Brushes," or as the case may be, not later than Eleven o'clock a.m. on Wednesday, the 26th day of October instant.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By Order, G. E. LILLIE, Secretary.

Nicholas-lane, London, E.C. 4, 12th October. 6426

Watford Urban District Council.
WATERWORKS.
CONTRACT No. 14.—SERVICE RESERVOIR.

The Watford Urban District Council is prepared to receive TENDERS for the CONSTRUCTION of a COVERED SERVICE RESERVOIR at Merryhill, Bushey, having a capacity of two million gallons.

Persons desirous of contracting for the work may see the plans, specification, and form and conditions of contract upon application to the Engineer, Mr. D. Waterhouse, Council Offices, High-street, Watford.

The schedule of quantities, specification, and form of Tender may be obtained from the Engineer upon payment of a deposit cheque of £10 payable to the Watford Urban District Council, which will only be returned upon the receipt of a bona fide Tender and the specification supplied to him.

Sealed Tenders and schedule, addressed to the undersigned Clerk to the Council, endorsed "Service Reservoir, Contract No. 14," must be delivered under cover to me at Watford not later than Monday, October 31st, 1921.

The Council does not bind itself to accept the lowest or any Tender.

W. HUDSON, Clerk and Solicitor.

Council Offices, 14, High-street, Watford, September, 1921. 6358

PUBLIC NOTICES

Bombay Port Trust.
ENGINEERING ASSISTANT.

The Trustees to the Port of Bombay REQUIRE the SERVICES of an ENGINEERING ASSISTANT with good experience of Girder, Bridge, and Roof Steel Work Design, Building Construction, and Heavy Masonry Work. Should preferably have obtained experience in connection with railway or dock work and have been some time with a good contractor. Capable of preparing designs and drawings and making calculations under the direct supervision of an Executive Engineer. Salary Rupees 850 per month, rising annually by Rupees 30 per month to Rupees 940, and, if married, with such married officers' house allowance as he may be eligible for under the rules of the service. Three years' agreement.—Applications, in writing only, stating age, education, technical qualifications, &c., with copies of testimonials, to the Consulting Engineers, BOMBAY PORT TRUST, 2, Queen Anne's-gate, Westminster, S.W. 1. 6434

City of Birmingham.
TRAMWAYS DEPARTMENT.
PERMANENT WAY ENGINEER.

The Tramways Committee invite APPLICATIONS from fully qualified engineers for the POSITION of PERMANENT WAY ENGINEER to the Tramways Department. Inclusive salary £750 per annum.

Applicants must state full particulars of qualifications, present position and past experience, and enclose copies of not more than three recent testimonials.

Applications, to be endorsed "Permanent Way Engineer," must be addressed to the undersigned and forwarded through the post so as to be received not later than first post on Monday, 31st October, 1921.

ALFRED BAKER, General Manager, Birmingham Corporation Tramways.

Tramways Department, Congreve-street, Birmingham. 6423

SITUATIONS OPEN

EFFICIENCY ENGINEER.—APPLICANTS for this POST are again THANKED for their communications, and are informed that a number of gentlemen have been selected for interview, who have been advised by post. 6389 A

WANTED, a WORKING ENGINEER, to Take Charge of a Factory Plant in Leicestershire; must have had experience in the Upkeep of Steam Engines, Boilers, Electric Lighting Plant and General Machinery.—Write, stating age, wages, and particulars of previous employment, Box 157, c/o Mather and Crowther, Ltd., 10/13, New Bridge-street, E.C. 4. 6515 A

PRACTICAL WORKS MANAGER WANTED for large Bridge and Constructional Works. Must be real live man, up to date in all modern practice and equipment and capable of fixing all classes of work, piecework. No one need apply unless they have occupied an exactly similar position.—Address, 6394, The Engineer Office. 6394 A

PROCESS ENGINEER WANTED by Large Electrical Firm in the North. Preference given to a man who has had a first-class experience of machining and assembling operation on electrical apparatus. Applicants must be able to process operations direct from drawings and to support process by extensive practical knowledge. Applications should give full particulars of experience, positions held, age, and salary required.—Address, 6418, The Engineer Office. 6418 A

REPRESENTATIVE REQUIRED for Bristol and South Wales district; also ONE for East Coast district, for Sale of High-grade Motor Construction and Tool Steels. Salary, expenses and commission will be paid. Applicants must have actual connection in these districts. Write, giving full details of experience, &c.—Address, P4205, The Engineer Office. P4205 A

REPRESENTATIVES (2) REQUIRED for High-class Woodworking Machinery Makers; must be very energetic, trustworthy, and first-class salesmen. Send full particulars, stating salary and commission required.—Address, P4187, The Engineer Office. P4187 A

TEA PLANTING.—An Important Tea Company has a VACANCY on its European staff for a YOUNG GENTLEMAN (age 22-24 and unmarried), WITH ENGINEERING EXPERIENCE, to become a Tea Planter on its gardens in Assam. The position would be under a three years' agreement commencing from the date of arrival at the gardens, and salary for the first year would be at the rate of Rs. 250 a month, rising by annual increments of Rs. 50 a month to Rs. 350 a month in the third year. First-class passage to the garden would be paid by the company.—Applications should be addressed to Box "ASSAM," c/o Davies and Co., 95, Bishopsgate, E.C. 2, and should contain full particulars as to age, education, and engineering experience. 6407 A

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SITUATIONS OPEN (continued)

ENGINEER.

THE SERVICES of a GENTLEMAN in the Above capacity are DESIRED by large Manufacturing (not Engineering) concern situate in the Greater London district.

Sound scientific and practical shop trainings essential.

It is necessary that applicants should be able to cope with problems in the nature of applied chemistry, as well as engineering, where labour and heavy machinery questions are concerned.

The above indicates that only engineers who have received sufficient early training enabling them to analyse varied and intricate engineering problems applied to the chemical industry, and have subsequently developed this side of engineering, need apply.

Age 38 to 40. State salary required and give personal references (testimonials not required).

Applications must be received not later than Tuesday, the 18th instant.—Address, P4197, The Engineer Office. P4197 A

WORKS SUPERINTENDENT REQUIRED by Manufacturers of Electric Accumulators, Midland counties. Must have good mechanical engineering experience and be accustomed to handle men. Knowledge of accumulator construction not essential.—Address, 6390, The Engineer Office. 6390 A

WANTED, First class DRAUGHTSMAN for Crane Works in Spain. Experience in all types Hand, Steam and Electric Cranes essential. Preference will be given to man with knowledge of Conveyor Plant.—Address, stating age, experience, if married, and salary required, 6430, The Engineer Office. 6430 A

WANTED IMMEDIATELY, Smart Young DRAUGHTSMAN, experienced in Design of Water-tube Boiler Lay-outs for Central Stations, &c. Good opening for smart man in London district.—Write, "L. D.," c/o Street's, 30, Cornhill, E.C. 3 6432 A

DRAUGHTSMAN, Experienced in Complete Boiler and Power-house Pipe Arrangements, capable of taking own dimensions on site and carrying jobs through without supervision.—Write, stating experience, age, and salary required, AITON and CO., Ltd., Derby. 6332 A

DRAUGHTSMAN.—WANTED, First-class MAN for Bridge and Constructional Works in country. Must be capable of working out stresses and designing and checking work through shops. Salary £4 10s. per week.—Address, 6393, The Engineer Office. 6393 A

TANGYES LIMITED REQUIRE the SERVICES of a HEAD DRAUGHTSMAN with good experience of Pump Work, Steam Engines, and Hydraulic Work. State qualifications, age, and salary.—Replies will be treated confidentially, and should be addressed Chairman, TANGYES, LIMITED, Cornwall Works, Birmingham. 6388 A

TWO or THREE First-class DRAUGHTSMEN REQUIRED for Aeronautical Work. A wide engineering experience, including shop training, with some experience of aeroplane work necessary. When applying give full particulars of training, experience, and salary required.—Address, 6364, The Engineer Office. 6364 A

REQUIRED for Works in the South of England, TOOL-ROOM MECHANIC. Must be a first-class man and experienced in the grinding and setting of all types of lathe tools, milling cutters, &c., and in their proper heat treatment. State wages required.—Address, 6398, The Engineer Office. 6398 A

SITUATIONS WANTED

AERIAL ROPEWAYS, TELPHERAGE.—DESIGNER and ERECTOR, Light Structural Work, SEEKS POSITION. Excellent references.—Address, P4198, The Engineer Office. P4198 B

BUYING ENGINEER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT. Services will be available in two weeks' time.—Write, Z. M. 615, c/o Deacon's, Leadenhall-street, E.C. 3. 6400 B

CIVIL ENGINEER, 15 Years' Experience on Large contracts, accustomed to setting out and managing all classes of construction, reinforced concrete, steel, &c., experience in harbour work, tunnelling, railway construction and surveys, hydrographic work, petroleum boring, &c.—69, Cobham-road, Kingston, Surrey. P4188 B

CIVIL ENGINEER, Young, Energetic, College technical training, A.C.G.I., Stud. Inst. C.E., and short works experience, DESIRES PRACTICAL EXPERIENCE in Railway or Structural Work. Good draughtsman. Go anywhere. Living salary at commencement.—Address, P4202, The Engineer Office. P4202 B

COMMERCIAL REPRESENTATIVE.—ENGINEER, valuable all-round experience, sole charge of large contracts, home and abroad, building construction and power installations, DESIRES suitable POST or REPRESENTATION, abroad preferred. Excellent references. Willing go anywhere. Good French and Spanish.—Z. G. 713, c/o Deacon's, Leadenhall-street, London. 6429 B

ENGINEER, A.M.I.M.E., DESIRES APPOINTMENT; experience with boilers, I.C. engines, centrifugal pumps, &c. Controlled large workshops in the East, employing 500 Indian and Arab mechanics; 5 years' commissioned service with Royal Engineers. Knowledge Hindustani.—Address, P4209, The Engineer Office. P4209 B

ENGINEER, A.M.I.M.E., &c., OPEN for Suitable APPOINTMENT. Many years' experience in factory planning, machinery lay-out, erection of buildings and plant for various purposes, including seed crushing, compound meals, edible oil refining, chemical processes, steam and electric installations, conveying machinery; also experience in modern methods of factory administration, economical working, &c.—Address, P4148, The Engineer Office. P4148 B

ENGINEER, A.M.I.C.E., Shortly Commencing practice as consulting engineer in South Wales, PREPARED to ACT as TECHNICAL REPRESENTATIVE for a Firm of repute. Sound experience in modern iron and steel practice, also tin-plate and sheet mills and collieries. London, North of England, and South Wales experience. Good connection with principals.—Address, P4127, The Engineer Office. P4127 B

ENGINEER, Mechanical (35), B.Sc., A.M.I.C.E., 17 Years' experience at home and abroad, marine shop trained, drawing-office, supervision new construction, sales and general commercial experience, SEEKS RESPONSIBLE POSITION as COMMERCIAL ENGINEER. Disciplinarian, hard worker, used to control. Technical correspondent in French and German and fair knowledge Spanish. Public school education.
Address, 6443, The Engineer Office. 6443 B

ENGINEER (31) REQUIRES PROGRESSIVE POSITION, Assist. Mechanical Engineer or Assist. Works Manager; 16 yrs. practical and theoretical experience of steel works' maintenance and internal combustion engine work.—Address, P4191, The Engineer Office. P4191 B

ENGINEER (35), 7 Years Chief D.O., 2½ Years Charge of works, REQUIRES BERTH; experienced switches, crossings, lay-outs, rims, tires, axles, foundry, plant maintenance, &c.—Address, P4126, The Engineer Office. P4126 B

ENGINEER, Technical Qualifications, REQUIRES APPOINTMENT, to add to practical experience; lower salary accepted.—Address, 6410, The Engineer Office. 6410 B

ENGINEER, with Exceptional Experience, is DESIROUS of a reponsible POSITION with a Firm of Constructional Engineers in the works or offices or charge of district office.—Address, P4199, The Engineer Office. P4199 B

SITUATIONS WANTED (continued)

FULLY Qualified ENGINEER, with Considerable experience in steam, electric and conveying installations, the lay-out and working of plants for seed crushing, compound meals, edible oil refineries, chemical processes, and general machinery is OPEN to ACT as CONSULTANT, giving advice and full reports, preparing specifications, and negotiating the purchase of plant either for home or abroad.—Address, P4149, The Engineer Office. P4149 B

GRADUATE (22½), ex-Service, DISENGAGED; four years tech. coll., B.Sc. and Diploma in Engineering; civil, mech. and elect. training; good draughtsman; surveying, dry instrument; would work under agreement for moderate wage and good experience.—Address, P4192, The Engineer Office. P4192 B

KEEN, Energetic ENGINEER (37), with Full Commercial experience, WISHES responsible POSITION. Full knowledge buying, costing, sales, publicity, home and export; can take complete control and carry on successful development.—Address, P4206, The Engineer Office. P4206 B

MANUFACTURERS. — If Desirous of NEGOTIATING with an ENGINEER travelling Lancashire, Yorkshire, &c., to UNDERTAKE some SPECIAL WORK, address, in first instance, P4181, The Engineer Office. P4181 B

MECHANICAL ENGINEER, 13 Years' Good General experience as manager and foreman, also costing and travelling, SEEKS responsible POST, any capacity.—Address, P4118, The Engineer Office. P4118 B

NAVAL ARCHITECT (Practical), Certified Theory, Survey, reports, specifications, WILL SUPERVISE CONSTRUCTION or repairs to vessels, home or abroad; would invest with services in repairing firm.—Address, P4184, The Engineer Office. P4184 B

PUSH.

EX-OFFICER, with Energy, SEEKS EMPLOYMENT, abroad or in Colonies. Qualifications:—Engineering, marine or air work, organisation, control of men. Languages:—English, French and Spanish. Thorough practical and theoretical engineering experience, F.R.Ae.S.; held commands during war from 200 to 1200 men, also native labour parties. Rank at end of war, Lieutenant-Colonel. Excellent testimonials last 12 years. Will you employ, or

ARE YOU GOING TO LET YOUR BUSINESS DRIFT?

Address, at once, P4194, The Engineer Office. P4194 B

RUSSIAN ENGINEER, with 17 Years' Experience in general contracting and railway construction work, REQUIRES POST; age 44; nominal salary for suitable work, locality immaterial.—Address, P4178, The Engineer Office. P4178 B

SCIENTIFIC and MECHANICAL ENGINEER REQUIRES SITUATION, home or abroad; thoroughly experienced in machine and shop practice, scientific and optical instruments and automatic machines; capable draughtsman-designer; progressive position required.—Address, P4177, The Engineer Office. P4177 B

TO GAIN EXPERIENCE.—EX-SERVICE MAN, aged 22, REQUIRES POST in engineer's office in or around London; no salary required; 3 yrs. coll., City and Guilds Diploma, Civil and Mech. Eng. Inter. B.Sc. (Eng.). Stud. Inst. C.E.; interview requested.—V. F. DOREY, 23, Elmcroft-street, Clapton, E. 5. P4190 B

WEIGHBRIDGE CLERK WANTS SITUATION, used to engineers' works, also time recorders, wages sheets, railway traffic; age 48.—Address, SEWELL, 4, Oxfield-street, Lincoln. P4173 B

WORKS MANAGEMENT.—ENGINEER, with 20 years' experience amongst large works plants, textile, chemical, &c. (4 years as works manager), DESIRES RESPONSIBLE POSITION as ENGINEER-MANAGER; salary about £600 p.a.—Write, X. D., c/o. J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 6408 B

YOUNG CIVIL ENGINEER, Aged 20, REQUIRES JUNIOR POSITION; 3 years' college training, B.Sc. Eng. (Lond.).—Box 297, Scripps', South Molton-street, W. P4169 B

DRAUGHTSMAN (32) DESIRES BERTH; 17 years' good abroad engineering experience.—Address, P4201, The Engineer Office. P4201 B

MECHANICAL DRAUGHTSMAN (25) DESIRES SITUATION, any capacity; 6 years' machine, fitting and erecting shops and 7 years' D.O. experience on steam turbines, engines, direct-acting steam pumps, condensers, &c., with reputable firms.—Address, A. H. HYDES, Clifton, Rugby. P4180 B

MECHANICAL DRAUGHTSMAN, with Wide Experience in the design and lay-out of various industrial plants, power station design, &c., DESIRES SITUATION; City office preferred.—Address, P4170, The Engineer Office. P4170 B

THOROUGHLY Experienced TRACER SEEKS POST.
Anywhere. Excellent references.
Address, P4204, The Engineer Office. P4204 B

YOUTH, Age 18, REQUIRES SITUATION as JUNIOR DRAUGHTSMAN.—M., 1, Blomfield-street, Bury St. Edmunds. P4162 B

FOREMAN ANGLE and BOILER SMITH DESIRES CHANGE. Thorough practical experience on Admiralty, merchant, shipbuilding and constructional work. Good organiser; strict disciplinarian. State salary.—Address, P4200, The Engineer Office. P4200 B

MACHINE SHOP FOREMAN, 12 Years' Experience, SEEKS BERTH; well versed modern shop practice, speeds, feeds, tools, jigs; expert capstan turrets, &c.; age 36; mod. sal. to start.—Address, P4172, The Engineer Office. P4172 B

SMITHY and FORGE FOREMAN; 12 Years Foreman, marine and general engineering, forging presses, heat treatment, fixing piecework prices, technical training, advanced methods, tactful.—Address, P4107, The Engineer Office. P4107 B

A FIRST-CLASS ANGLE IRON SMITH REQUIRES EMPLOYMENT, any class of work; P.W. preferred; P.C. Sec.—Apply by letter, A. P. 47, Hope-street, York-road, Battersea, London, S.W. 11. P4182 B

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Original Makers of WELDLESS STEEL TUBES of Water-tube Boilers, Locomotive Boilers, Superheaters, Shafting Hydraulic Work, Boring Rods, etc.
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PARTNERSHIPS

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Established seventy years.

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The Electrification of the Swiss Federal Railways.

No. III.*

II.—ADDRESS BY DR. WYSSLING, RECTOR OF THE TECHNISCHE HOCHSCHULE, ZURICH, GENERAL SECRETARY OF THE COMMISSION OF STUDY.

Professor Wyssling opened his remarks by referring to the Commission of Study, the labours of which were ended in 1912. The Commission was formed in 1904 in order to investigate thoroughly the problems of electrification and thereby to utilise available water powers and at the same time open up new channels for the Swiss electrical industry. From the outset it brought together, often with much difficulty, the various interests, and in its wide investigations included the thorny question of the rival systems. The results which were arrived at and published, are not therefore one-sided personal views, but are the conclusions reached by the several Swiss experts including the representatives of the manufacturers. Since the publication of the reports no facts have arisen which could upset the conclusions of the Commissioners; on the contrary, practical experience has confirmed their judgment, and in some cases even shown greater developments along the lines indicated than could have been anticipated.

It was with the economic side that the speaker was chiefly concerned in his address. In some cases, however, economics are so bound up with technical questions that separation was impossible.

Relative Costs of Steam and Electric Traction.

The first question is whether the working of the Swiss railways by electricity obtained from water power will be cheaper, or at least as cheap, as working by steam. The Commission of Study found that it would be cheaper. Based on the results of 1908, the total cost per ton-kilometre for the St. Gothard line was estimated to be over 25 per cent. lower with electricity—single-phase—than with steam, though the higher speeds assumed for electric haulage required 10 per cent. more energy. Since these estimates were made in 1911 it has been found on the Lötschberg line that the energy costs were about two-thirds of what they would have been with steam locomotives, a result that would improve still further the electric working of the St. Gothard by 6 per cent. The latest results for the Engadine sections of the Rhaetian line agree closely with the figures assumed by the Commissioners. The locomotive efficiency taken over the whole Lötschberg journey comes out appreciably higher than was assumed by the Commissioners for similar locomotives. The results of the New York, New Haven Railway, on which steam generating stations are used, also show that electric is cheaper than steam working. Though steam power is cheaper in America than in Switzerland, it is not so cheap as Swiss water power. An increase of 20 per cent. in the price of coal above the prices ruling in 1904 would lead to an extra saving of 25 to 30 per cent. with electric traction. Thus experience has shown that the Commissioners were not too optimistic in their estimates of energy consumption and of economy. But the position with regard to the rate of interest, which was taken as 4 per cent., has also changed for the worse. It has to be borne in mind, however, that as time goes on the working costs with electricity decrease, because as the capital costs are written off and the waterfalls are better utilised electrical energy will become cheaper; with coal there will be no such reduction.

It is very difficult to estimate the saving that would be effected by electrifying the whole railway system in Switzerland. The sum spent yearly on coal for all the Swiss railways, at pre-war prices, will in the immediate future exceed 20 to 25 million francs. Increases in traffic and rises in price may add to this amount considerably. The total capital required in connection with the electrification of the whole railway system, including generating stations, &c., depends largely on the selection of the waterfalls and can be roughly estimated at 350 to 500 million francs. At the moment only a part of the St. Gothard line is under consideration, and for the electrification of it the cost will be about 70 million francs, or about 14 million francs per annum for the section about to be electrified. Because of economies in working, even if the interest of the new capital equalled the 20 to 25 million francs saved in coal, it would still be of great advantage to electrify the railways.

Is Sufficient Water Power Available for Working the Whole Swiss Railway System?

Statistics show that as technical progress is made the amount of utilisable power is increased and that this power is several times greater than any demand which within measurable time can be made for industrial lighting and railway services together. Assuming an increase in railway traffic of 100 per cent. over that in 1904, the Commissioners found that the Swiss railways would have a peak load of 500,000 and a mean load of 150,000 horse-power, or a yearly demand of about 1300 million horse-power-hours. To supply this demand the Commissioners considered that about a dozen waterfalls, hitherto unused, would be capable of giving peaks of 500,000 to 700,000 horse-power and a yearly output of 1300 to 1800 million horse-power-hours. It is thus clear that at the present time there are sufficient suitable waterfalls available for the whole railway service.

Ought Railways and Industry to be Supplied from a Common Network?

There next arises the question whether the railways will make the best use of the water power available or whether this national asset will be in part wasted. It has been confidently asserted in the Press that it is very uneconomical to use water power for railways alone, and that it is essential to supply other services also in order to use the available power efficiently. Considered in the abstract, it would appear that traction services do not make effective use of water power by virtue of the big difference between the peak load and the average load. Even for large works supplying wide areas with dense traffic, such as the St. Gothard Railway, the Commissioners found the peak load to be about three times the average load, taken over the whole year. With sparse traffic this ratio may reach four. Consequently, whereas in the case of low heads no provision is made for storage, only one-third to one-quarter of the available power is utilised. On the other hand, with high heads having unlimited storage capacity by damming, the whole power can obviously be used, if the machinery and pipe lines are designed for three times the average load. At the same time it must be remembered that even in large power and lighting stations the utilisation is not much better, for in that case also the peaks are three to four times the mean load.

In general, it is not to be recommended that power not required by the railways, particularly during those parts of the day when the railway load is lowest, should be supplied elsewhere, even though the load changes of the railway may be fairly well known; yet fluctuations are much more frequent than with lighting or power loads, so that the supply of excess power will be very uncertain, thus rendering it difficult to obtain consumers. The critic suggested that generating stations should be designed for very large powers at the outset, since these alone can be designed economically; and since at first the local demands would be insufficient to load the station efficiently, it becomes necessary to supply power in bulk to other undertakings. It is concluded, therefore, that all railway works should be built for generating three-phase current at 50 cycles—the standard supply for lighting and power—and as the demand for the railways increased the amount supplied to industry should be reduced. Thus power stations should not be built for generating 15-cycle single-phase current for the railways, and indeed this system should not be used at all for traction.

After mature consideration, Professor Wyssling could not agree with the above proposals. Even assuming that stations were built for supplying energy to both railways and to industry, the two services must be kept independent, as was proved in the case of the Burgdorf-Thun Railway. With common working the fluctuations in the traction load are found to be intolerable for lighting and power.

Not only is it undesirable to supply power for railways and for lighting from the same turbines, but in many cases it is necessary to use separate pipe lines. Assuming for the sake of argument that such mixed stations are necessary, the whole machinery must be divided for the two services. The chief cost of hydraulic stations is not, however, in the machines; consequently it will not make much difference in the total cost if, in such a combined station, two types of generators—one for 50-cycle three-phase current, the other for 15-cycle one-phase current—are installed. The increased cost is mainly entailed by the reserve generating set. Examples worked out show that the increased capital costs only augment the total running costs of the railway by from 1 to 2 per cent. Even in the worst case, when the three-phase generators in a mixed station might have to be replaced by single-phase generators before amortisation, on account of rapid traffic increases, the running costs would be increased by 2½ to 3 per cent. only. Thus even if mixed stations were necessary, there would be no need to avoid the single-phase system.

It is maintained, however, that these complications have not to be considered by the Federal railways. The railways—by virtue of possessing their own stations—are situated much more favourably than undertakings supplying lighting and power. Stations can be built as the electrification of the different sections proceeds and these stations, in many cases, can be fully equipped at the outset. In exceptional cases in which that course is not possible it would be better to build the station suitable for railway supply and utilise the temporary excess power that is available either by converting it from single-phase into the standard three-phase or by installing three-phase generators, which would be replaced by single-phase generators as the railway load increased.

The rational utilisation of the water powers appropriated by the railways will be obtained in the well-known way adopted by large electricity undertakings in Switzerland, namely, by the linking up of stations working on more or less constant low-head falls without storage capacity with stations utilising high-head falls having ample storage capacity, a procedure which enables the low-head falls to be nearly always fully utilised, while the peak loads are supplied by the high-head falls, which are also fully utilised by impounding the water. It was this idea which guided the Commissioners in their later study on the selection and utilisation of water powers. For supplying energy for the whole railway system five or six stations, having high heads and ample storage facilities, were planned to work in parallel with five to eight other stations, some with high and others with low heads, where no accumulation of water was possible. Fairly good results can be obtained in this way, the storage stations being fully utilised and the low heads at any rate more fully than has hitherto been the case in stations supplying lighting and power.

Effect of Continuous Current on Costs.

The investigations of the Commissioners have shown that the conversion of power entailed by the use of continuous current makes the cost of energy at the overhead conductor more than twice the cost of single-phase energy. This fact would result in an increase of 30 per cent. in the running costs over that of single-phase requiring no conversion. Such a difference, even the substitution of converters by mercury rectifiers—assuming that these could be made for the requisite output and power—could not easily wipe out. The increase in the working costs would thus be much more than equipping the stations partly for 50-cycle three-phase current at the outset and later converting to single-phase machines. It is in the conversion of the energy that the great increases in cost are to be sought. The opinion of the Commissioners that the single-phase system possesses the greatest technical advantages has been proved by experience.

Discussion.

In the discussion which followed the reading of the two papers, summarised above and in the previous articles, Herr Sand, General Director of the Swiss Railways, explained the attitude of the Federal Railways to the question of electrification and the present position of affairs. The Commissioners concluded their investigations in 1912 and reported to the Federal Railways that the single-phase system appeared to be not only the best for the St. Gothard line, but for the electrification of the whole system of the Federal lines. Accordingly, in November, 1913, the Administration requested the Federal Railway authorities to sanction a project for electrifying the St. Gothard line from Erstfeld to Bellinzona, and for that purpose to vote a credit of 38.5 million francs. This request was agreed to. At the conclusion of the chapter on the adoption of a system the Commissioners stated that: "At the same time we do not wish at the moment to make a final pronouncement on the choice of a system, and we shall continue to study the subject closely until the progress of the works renders a definite decision essential." The possibility must be kept in mind, therefore, that when work was begun the single-phase system might no longer be supreme. It had been stated that the question of the system ought to be settled before constructional work was begun. Such a course, however, was not necessary, for a start was made with the hydraulic works, which would demand the greatest time. The question of the system, however, must be settled as soon as possible, and instructions had been given for the matter to be gone into thoroughly and reported upon. Starting constructional work before the system was settled would not, therefore, cause delay. It was thus seen that the Federal Railways were in earnest and fully appreciated the advantages of electric traction.

Herr W. Boveri, of Baden, said that in his opinion the generating stations for the railways should adopt what had become the standard system, namely, the three-phase system at 50 cycles. The general development in the generation and utilisation of electric energy pointed to the linking up of stations—particularly river stations having low heads and no storage capacity with stations in the hills having high heads and storage facilities—*e.g.*, the Beznau and Lönsch stations. Also the interchange of energy between stations had been successful; the stations at Wangen, Rheinfelden, Beznau, Lönsch, and Albula were all linked up with one another without trouble of any kind, thus showing how far interlinking could be extended. In the future extensions would be made and dams would be built to increase the power obtainable from low heads; yet it was now proposed to develop the largest consumer in such a manner that linking up with other stations would be impossible. According to the speaker's experience, the linking up of different stations through frequency changers was impracticable on account of its cost.

Many people, he continued, were of the opinion that the railway generating stations ought to be independent and not linked up with other stations. The speaker could not agree with them, since in the developments during the last twenty-five years linking up had become more and more practised. Originally even lighting and power supply were kept apart. Now they were no longer separated, and it was probable that in the future railways would also be linked up to a common system. Herr Boveri also did not agree with the opinion that because the railways would be both producers and users of their own energy it would be extremely simple to develop and extend the stations as required. The concessions, plans and works for a new station required three to

* No. II. appeared October 7th.

six years, which was too long a period for rapid development of traffic; while to obtain power by conversion was impracticable. Even if rapid traffic developments were anticipated and a new station were built in advance, the degree of utilisation at the outset would be very poor. The excess energy having to be converted would find no user, while to install special 50-cycle generators to be gradually replaced by generators for railway supply would be too costly. The most natural and rational development was a standard system of generating power for all purposes with the stations permanently linked up so as to equalise the excess of power in some places and the deficiency in others. If the railways required 1200-1300 million units they must have in addition 200–500 million units at their disposal, which, properly utilised, would add 1–3 million francs to the income of the Federal Railways.

In his reply, Professor Wyssling remarked that the Federal Railways would require about 500,000 horse-power—about as much as the present total of all the Swiss stations. There would be ten to eighteen stations, all linked up and without conversion. Having regard to safety in working and the technical control of that number of parallel stations, there was no need to go further and link up with all manner of other stations, which would add complications and difficulties. Certainly as electrification proceeded there would be times when the Federal Railways would have more energy available than they needed, but the erection of the several works for the 1200 million units—in which the needs of all private railways were included—would as far as possible be carried out as required. Increase in traffic led much more to an increased demand in the number of units, *i.e.*, to better utilisation of the stations, than to an increase in the peak loads, for the latter for any given section depended mainly on the number of trains that could be accommodated on the section.

The increased costs entailed by converting power from one system to another were not private views, but the results obtained by the Commissioners; while the difference in the running costs caused by the gradual replacement of 50-cycle generators had been obtained from actual calculations.

Recent Observations by Dr. Wyssling.

Professor Wyssling has added the following notes, dated January 17th, 1921:—"I have no reason to make any alterations to the address given by me on December 14th, 1915, in Berne. The experience which since then has been gained on the Swiss Federal Railways, and the principles which have been applied under the capable direction of Colonel E. Huber, have merely confirmed what I then said, which was solely a repetition of the results of the Commission of Study. In the case of power stations, which at the outset are not fully loaded by the railways, in addition to the main generators giving single-phase current at 15 or 16⅔ cycles for the railways, three-phase 50-cycle generators are to be installed to supply the general distributing network for power and lighting in Switzerland so long as an excess is available. This method has been followed in Amsteg, on the St. Gothard route, and will be followed at the Etzel station. The Federal Railways remain firm in their decision to supply the railways from their own 16⅔-cycle power stations.

"The advantages of the single-phase system which were previously set forth have been completely confirmed by the results of the St. Gothard and Lötschberg lines.

"Recently Dr. Behn-Eschenburg's simple method for regenerating single-phase energy has been applied in the Oerlikon locomotives for the St. Gothard line.

"The disadvantages associated with every system requiring the conversion of the energy, which disadvantages, according to our calculations, lay especially in the capital and *personnel* costs of the numerous sub-stations, have become still more pronounced by the increase in prices since 1915, particularly in those of machinery, buildings, and wages."

Developments in Power Station Design.

No. XIII.*

When blast-furnace gas is used for driving engines instead of for raising steam, an efficient gas-cleaning plant is essential. After the gas has been treated, it should have small dust and moisture contents, and the cost of operating and maintaining the plant should be low. A plant, which, according to Mr. S. H. Fowles, meets the requirements admirably, is the Halberg Beth plant, as shown in Fig. 63. Its advantages, as set forth in Mr. Fowles' paper on "The Production of Power from Blast-furnace Gas," read before the Institution of Electrical Engineers in March of last year, are as follows:—The bulk of the potash is recovered in its original state; the water in the gas is to a large extent removed; the dust contents are very low, the average being .002 gramme per cubic metre; the plant can be worked for long periods up to 30 per cent. overload; and the moisture in the gas can be removed or allowed to remain at will. The total water content averages about 15 grammes per cubic metre. This, of course, is very low, and makes the gas specially suitable for use in engines, and also for firing boilers, but especially for engine use. Originally, the plant was designed for dealing with gas for firing boilers, and in this case a relatively high dust and moisture content can be tolerated. Alterations were, however, afterwards made in order to ensure that the plant removed sufficient dust and moisture to enable the gas to be used in engines.

This particular gas-cleaning plant, which is used in connection with a power plant which uses blast-furnace gas for generating electricity, consists of three filter units, each having eleven double compartments, with a total nominal capacity of 3.3 million cubic feet of gas per hour, and is provided with fans which will deal with 4 cubic feet of gas per hour.

The total area of the filtering medium is 16,632 square feet, and 5 per cent. of this area is automatically shut off every ten minutes for shaking and cleaning. The dust which is recovered in the process of cleaning the gas is about 50 tons per week, and is equal in potassium chloride to about 30 per cent. The general operation of the plant is as follows:—In the first place, the crude gas is cooled in the pre-coolers. The temperature is lowered from 200 deg. to 80 deg. Cent., and a large amount of dust and moisture is deposited. To allow the gas to pass through the plant with its moisture content superheated, and to avoid it being influenced by the surrounding atmosphere, which is liable to deposit moisture and so clog up the filter bags, the temperature of the gas is next raised by about 10 or 15 deg. The gas then passes the filter bags, and its dust is removed, and after passing through the main fans, it is finally delivered by them to the various points of consumption. Immediately above the main fans, and on the suction side a main is connected up to the counter-blast fan which delivers a quantity of cleaned gas through a re-heater to the clean side of the bags in the various compartments alternately. During this operation the shaking gear operates a double-way valve, which cuts off the main fan suction for the particular compartment that is being cleaned, and opens the path for the clean counterblast gas, which has a pressure a few inches above that at the bottom of the pre-heater. The counterblast flows through the bags, takes the dust from the inside, and passes on with the gas to be cleaned.

The electric generating plant associated with this particular gas-cleaning plant consists of seven sets of twelve-cylinder tandem vertical 1500 horse-power gas engines, which are directly coupled to 1000-kilowatt three-phase alternators running at 200 revolutions per minute, and they work in parallel with a public electric supply, as suggested in the report of the Coal Conservation Sub-committee. Mr. Fowles estimates that the number of units which could be generated from the gas derived from fifty blast-furnaces is equal to the number which was sold during 1911–1912 by the 303 electricity undertakings in the United Kingdom.

It has been contended in a fair number of papers dealing with the utilisation of blast-furnace and coke oven gas that the best and most economical practice is to use these gases for driving engines instead of for raising steam. This is the opinion expressed in Mr. Fowles' paper, and also in a paper read some time ago before the Society of Chemical Industry. The cost of generating electricity by means of boilers and turbines is shown in the latter paper to be approximately 25 per cent. higher than the cost of generating it by means of gas engines. The remarks of Major Gregson at a meeting of the South Wales Institute of Engineers are, however, of interest. Dealing with this matter, Major Gregson said: "It is an accepted fact that modern gas engines will give 1 shaft horse-power for every 10,000 B.Th.U. in the gas. In fact, this figure has been reduced to 9500 B.Th.U. in several officially noted tests. The value 10,000 gives an overall thermal efficiency of gas energy to shaft energy of 25.5 per cent. On the other hand, numerous examples are also quoted of turbines giving 1 shaft horse-power

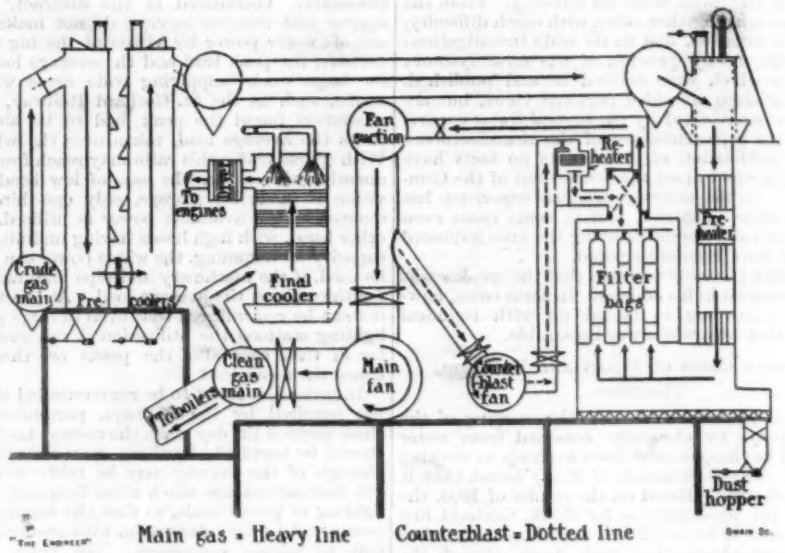


FIG. 63—DIAGRAM OF HALBERG-BETH BLAST FURNACE GAS CLEANING PLANT

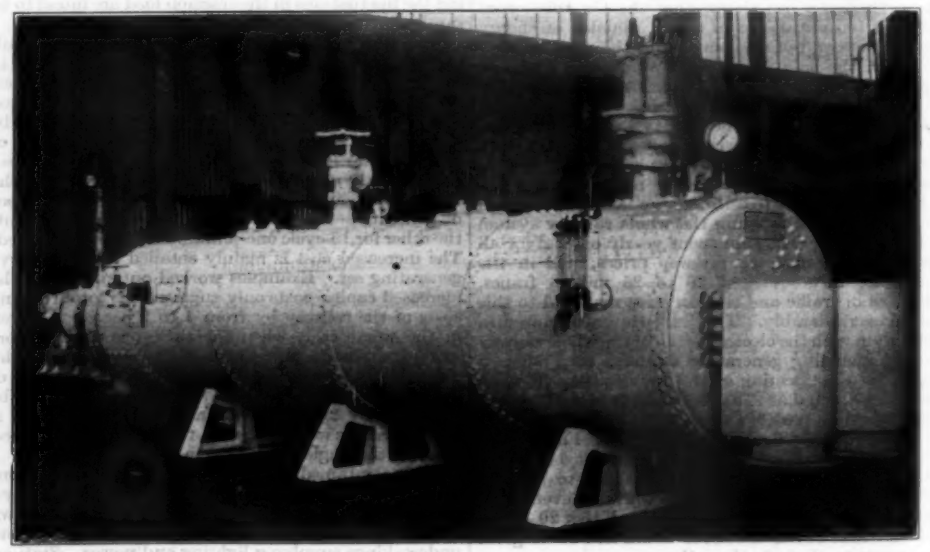


FIG. 64—EIRKE WASTE HEAT BOILER WITH INTEGRAL ECONOMISER

* No. XII. appeared October 7th.

for 10,000 B.Th.U. in the steam, and in the case of the Ljungström turbine, which is specially designed for high pressures and high steam temperatures, an example is quoted where a 5000-kilowatt turbine set working at a pressure of 300 lb. per square inch, and with a total steam temperature of 750 deg. Fah., gave a steam consumption of 6.5 lb. per shaft horse-power per hour. This works out at 9000 B.Th.U. per shaft horse-power from the steam. Assuming a Bonecourt* boiler working at an efficiency of 90 per cent. were employed with such a turbine, this figure would become 9000 divided by .9, which equals 10,000 B.Th.U., as gas energy per shaft horse-power. In other words, the combined efficiency of turbine and boiler is now equal to that of the gas engine, *i.e.*, 25.5 per cent.

"Presumably, the above figure, 9000 B.Th.U. for the steam consumption per shaft horse-power, represents ideal conditions, but it seems possible to obtain a shaft horse-power for 10,000 B.Th.U. under normal industrial conditions, and combining this with a Bonecourt boiler of 90 per cent. efficiency, gives 1 shaft horse-power for just over 11,000 B.Th.U. in the gas, this being an efficiency of 23 per cent. I have in mind in this connection a 1000-kilowatt set working at a steam pressure of 210 lb. per square inch, with a total steam temperature of 710 deg. Fah. We therefore come down to the fact that a suitably designed turbine combined with a Kirke boiler will give under good conditions the thermal efficiency of a big gas engine, and do nearly as well under ordinary conditions. This deficit is more than balanced by the following advantages of a turbine and boiler installation :—(*a*) The first cost of the plant is considerably lower than the first cost of the gas engine installation, and the annual allowance for depreciation and interest on capital is lower. (*b*) The cost of maintenance of steam plant would be lower than that of the gas engine plant, owing to the simplicity of the former. (*c*) In the case of units working on blast-furnace gas, the cost of cleaning the gas would be less in the case of the boiler plant, as the boiler only requires partially cleaned gas, whereas cleaning must be carried to a much higher degree for gas engine work."

Experiments carried out with the Bonecourt—or now so-called Kirke—boiler, as described in THE ENGINEER of September 23rd, are said to have shown that there is no difficulty in dealing with blast-furnace gas, and that the use of pre-heated air is an advantage. The time taken to start up a boiler with this gas is necessarily longer than the time needed with a richer gas, as it is necessary to feed in the gas slowly at the commencement of the run and gradually to increase the temperature of the tubes, otherwise the flame is liable to be quenched. Blast-furnace gas is usually delivered to boilers at a variable pressure, and for really efficient working it is perhaps advisable to install apparatus for giving a constant pressure; but this is not absolutely necessary, as even in the event of the gas supply occasionally falling off entirely, the flame can always be renewed by pilot jets fed from some other source.

The Kirke boiler, made by Spencer Bonecourt, Limited, and described in our issue of September 23rd, is being used in a fair number of industrial establishments for utilising the waste heat in the form of gas engine exhausts, and the heat available for various kinds of furnaces, retorts, &c. Owing to the fact that air cannot leak into the waste gases, and so cool them, the fire-tube boiler is claimed to be the best class of boiler for utilising waste heat, and especially when working with induced draught. The general arrangement of the Kirke true waste heat boiler is very similar to that used for gas firing, with the exception that no burners are required, and that the superheater is generally placed at the inlet side of the boiler, and not between the boiler and the feed-water heater. The adoption of the company's system for the utilisation of waste heat results in small boiler dimensions, and a high thermal efficiency. When tube packing is used, the heat transmission through the walls of the tubes is increased by the radiating heat, and the hot gases are also caused to impinge repeatedly on the tube walls.

A boiler which works at 180 lb. per square inch and which will generate 10,000 lb. of steam per hour with coke oven gas or 8000 lb. per hour with producer gas, is shown in Fig. 64. The diameter is 5ft. and the overall length with the integral economiser is 21ft. Tests have shown that the efficiency is 90 per cent. It is said that by using a moderately high suction, which incidentally also reduces the size and therefore the cost of the installation, the dust contained in waste gases can generally be made to pass through the tubes. In some cases, however, no internal tube packing is used. Much smaller tubes than the standard tubes are then adopted to increase the heating surface, and by suitably proportioning the length to the bore to suit the draught and temperature of the products, the efficiency of the boiler can, it is said, be maintained. If an automatic feed-water regulator is fitted, these waste heat boilers require no attention and no fuel. The discharge temperature of a gas engine averages 450 deg. to 500 deg. Cent., and contains some 40 per cent. of the total heat supplied to the engine in the form of gas. This heat can be utilised at a high efficiency with this type of waste heat boiler. In one particular case a 500 horse-power gas engine running twelve hours a day and six days a week at 80 per cent. of its full load, has its exhaust dealt with by a Kirke boiler, which gives 1100 lb. of steam per hour from and at 212 deg. Fah., at 80 per cent. full load. This represents a saving of about 300 tons of coal per annum. Experience has shown that with gas engines up to 100 brake horse-power, the best results are obtained by passing the exhaust through feed-water heaters and not steam boilers, the hot water being used for feeding boilers or for industrial or heating purposes. When these Kirke boilers are used for raising steam from gas engine exhausts, steam at the full working pressure is available in about thirty minutes after the gas engine is started.

The hot gases discharged from industrial installations, and especially non-regenerative furnaces, often contain over 70 per cent. of the heat available from the fuel. The following is a typical heat balance sheet for an ordinary open-hearth furnace :—

	Per cent.
Heat utilised in furnace	27
Radiation losses of furnaces and regenerators	29
Heat lost in producer ashes	3
Radiation losses from producers	10
Heat lost in flue gases leaving the system	31
	100

Assuming the coal burnt in the producers has a calorific value of 13,000 B.Th.U. per pound, every pound of coal gasified results in the passage of 4030 B.Th.U. up the chimney. Of this amount, a Kirke boiler will recover 80 per cent., or, say, 3200 B.Th.U., or 2.8 lb. of steam at a pressure of 120 lb. per square inch raised from cold feed water. The value 80 per cent. is taken as a typical average, but the value naturally depends on the temperature and the specific heat of the inert gases. Under the above conditions, a 35-ton furnace, consuming 3000 lb. of coal per hour, will give 8400 lb. of steam per hour, and of this amount, not more than 5 per cent. will be used in driving the suction fan, thus leaving about 8000 lb. of steam per hour for power purposes. The heat balance sheet now becomes :—

	Per cent.
Heat utilised in furnace	27
Heat utilised as steam	23
Radiation losses, furnaces and regenerators	29
Radiation loss from producers	10
Heat equivalent of fan power	2
Heat lost in producer ashes	3
Heat lost in flues, leaving boiler	6
	100

It will be seen that the percentage of heat utilised in the system by the introduction of the waste heat

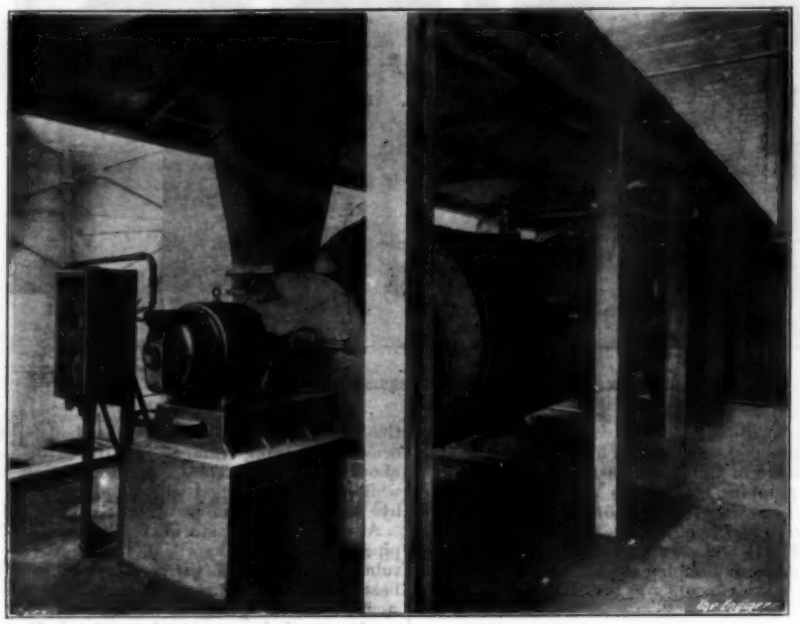


FIG. 65—COMPLETE WASTE HEAT INSTALLATION WITH FAN AND SUPERHEATER

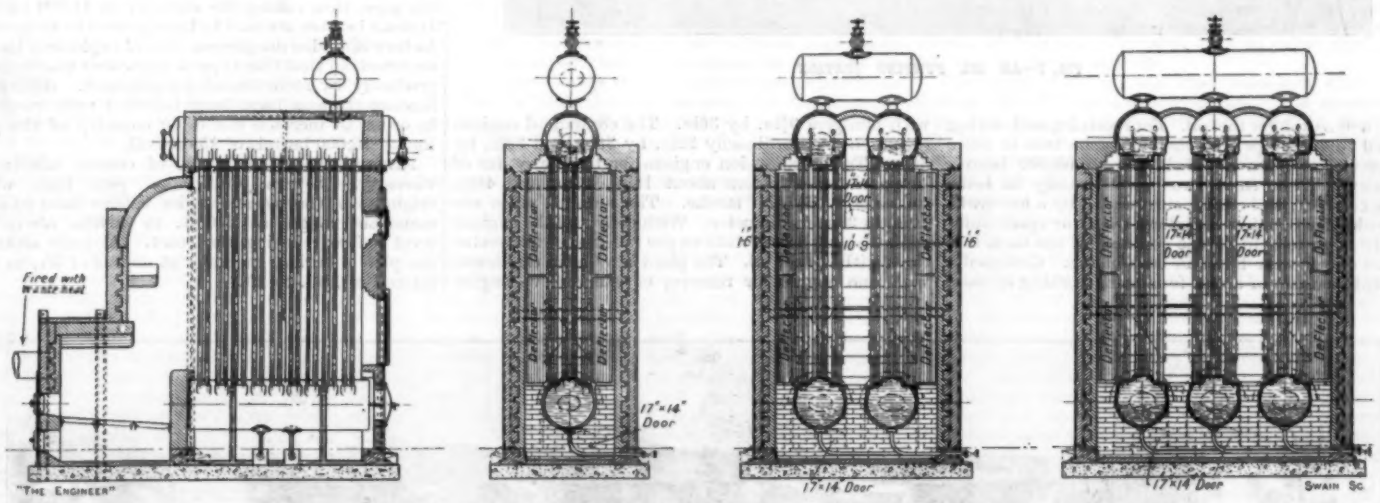


FIG. 66—WATER-TUBE WASTE HEAT BOILERS WITH VERTICAL TUBES

* Now known as the Kirke boiler.

boilers is increased from 27 per cent. to 50 per cent.

Fig. 65 shows a waste heat Kirke boiler installation, complete with the induced draught fan and superheater at the inert end of the boiler, the temperature of the waste gases varying from 550 deg. to 600 deg. Cent. The output of the boiler is 5000 lb. of steam per hour at a pressure of 120 lb. per square inch, and the total temperature of the superheated steam is 550 deg. Fah.

A waste heat water-tube boiler which is particularly suitable for gases at relatively low temperatures and gases which contain a fair amount of dust, is shown in Fig. 66. This boiler is one of the waste heat boilers made by John Thompson Water-tube Boilers, Ltd., of Wolverhampton. It will be seen that the tubes are perfectly vertical, instead of inclined, and that the gases pass through the tubes longitudinally. The object of this form of construction, which incidentally does not apply to all the waste heat boilers made by this firm, is to increase the velocity of the low-temperature gases, and to enable the dust to settle at the bottom of the boiler instead of on the tubes. The boiler is made with one, two or three nests of tubes, according to requirements, and, in addition to the gas inlet, fire doors are provided, so that in the event of the supply of waste heat failing the boiler can be fired with coal.

American Pipe Lines for Pumping Oil.

No. III.*

Of equal importance with the pipe lines are the pumping stations and pumping plants to force the oil through the pipe lines. The pumping stations are usually in open country at considerable distances from towns, and form small isolated settlements having telephonic communication with each other and with the headquarters offices. If steam power is used, the pumps and boilers are usually installed in separate buildings, in order to reduce the risk of fire. The station has also to include an office, houses for the employees, a barn or garage, a well, a water

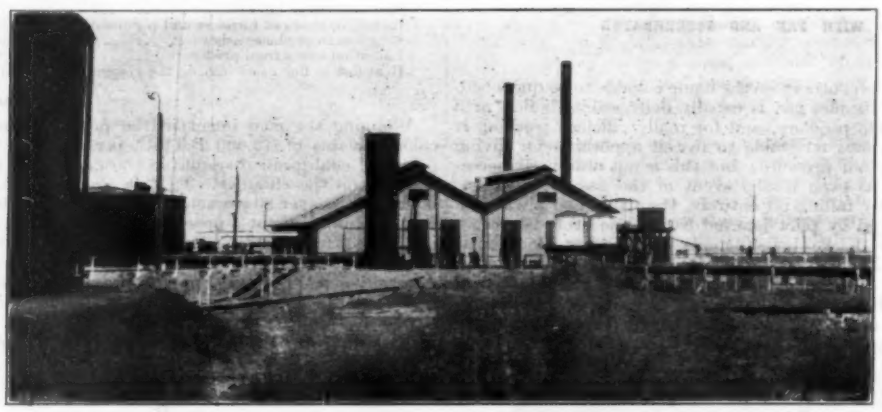


FIG. 7—AN OIL PUMPING STATION

tank, and a tank for fuel oil. For receiving and storing the oil for the pipe line there may be two or more cylindrical steel tanks of 10,000 to 60,000 barrels capacity. These tanks are placed usually at some distance apart, and each is surrounded by a low earth embankment forming a shallow reservoir space sufficiently large to hold all the contents of the tank if it should overflow or burst in case of fire. Ordinarily, the staff consists of about four men, working in pairs on alternate shifts. A typical pumping station is shown in Fig. 7, with the fuel oil and measuring tanks beside the engine-house at the right, the water tank or standpipe in front of the pump house, and the oil storage tanks at the left.

Oil Pumping Plants.

The nature of the pumping equipment for oil pipe lines depends primarily upon the quality and quantity of the oil to be handled, with the fuel and water supply as secondary though important considerations. Steam or internal combustion engines are selected according to circumstances. The engines are generally of the horizontal direct reciprocating type, but in some cases crank and fly-wheel engines are employed. The pumps are of the horizontal plunger type, and are designed usually to deliver through an 8in. main about 30,000 barrels of oil in twenty-four hours, with a pressure of 700 lb. to 900 lb. in the main.

Typical pumping stations on the oil pipe lines in California have from three to five water-tube or Scotch marine boilers of 200 to 250 horse-power each, burning oil fuel and serving two horizontal duplex compound steam pumping engines driving pumps with plungers 9½in. by 36in. The compound engines have cylinders ordinarily 22in. by 36in. and 38in. by 36in. Triple-expansion engines for the same size of pumps have cylinders about 18in., 28in. and 48in. diameter and 36in. stroke. The suction pipes are 20in. to 28in. in diameter. With heavy oil the engines run at about 12 revolutions per minute, or 22 revolutions with lighter oil. The plant may be in duplicate, with one engine for reserve, or the reserve engine may be of smaller capacity and used only in case of emergency or to permit of the overhauling and repairing of the main plant.

The degree of viscosity of the oil and the character of the longitudinal section of the pipe line, whether level or irregular, are the governing factors in determining the distance between the pumping stations. In the eastern and central districts this distance averages about 35 miles, but in California, where the oil is relatively thick and viscous, the average is only about 13 miles. The minimum and maximum distances between pumping stations are about 1½ miles and 90 miles respectively.

Heating the heavy oil to render it more fluid and thus facilitate pumping is practised very generally in California for oils having a lighter gravity than 16 deg. Baumé. The heaters are constructed in much

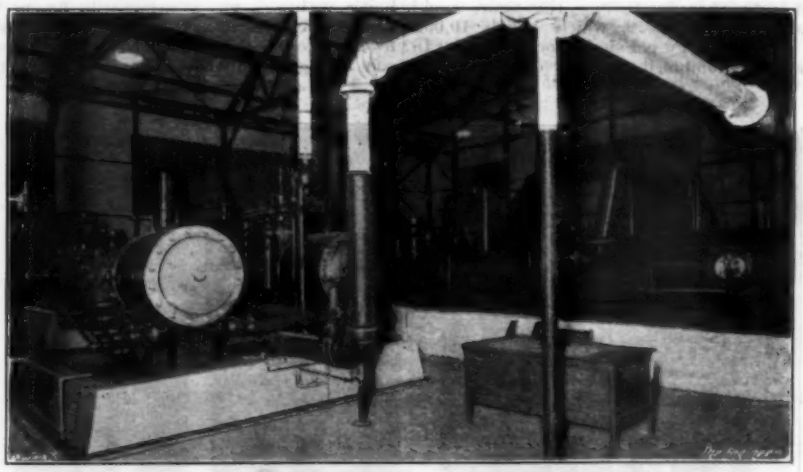


FIG. 9—MAIN AND AUXILIARY PUMPING ENGINES IN AN OIL PIPE-LINE STATION

the same way as horizontal tubular boilers, the cylindrical shell being from 4ft. to 7ft. in diameter and about 22ft. long. The oil passes through the tubes while the shell is filled with exhaust steam, or with live steam if high temperatures are required.

At every pumping station on the Coalinga-Martinez pipe line, already described, there are two outdoor tubular heaters, each with about 1100 square feet of heating surface. These heaters receive the exhaust steam from the pumping engines, much of the hot condensate being returned to the boilers from a filtering hot well. When pumping oils of the heavier grades a back pressure of about 2 lb. per square inch is maintained on the heater, the temperature of the oil being then raised to from 110 deg. to 140 deg. Fah. Relatively little heat is applied to the lighter oils, the amount added depending upon their viscosity and gravity.

Changes in the character of the oil, with a lowering of its specific gravity, occur from time to time in many districts. Thus on a 106-mile pipe line in California the original daily capacity—in 1904—was 5000 barrels of oil of 23 deg. gravity. A subsequent lowering of the gravity of the oil from the wells served by the line made it necessary to install additional pumping stations and more powerful pumps, so that in 1909 the daily capacity was 11,000 barrels of 17 deg. oil. To increase the capacity further, intermediate stations were built for re-heating the oil in the pipe, thus raising the capacity to 14,000 barrels. Hot-air heaters are said to have proved to be unsatisfactory and also dangerous, several explosions having occurred, so that this type of apparatus was replaced gradually by steam-heating equipment. Additional heating stations have been installed more recently, in order to increase the daily capacity of the pipe line to 15,000 barrels of 15 deg. oil.

Atmospheric temperature, of course, affects the viscosity. Several Californian pipe lines which originate in the warm interior valleys have to cross mountain ranges at 2500ft. to 4000ft. above sea level before reaching the coast. At such altitudes the pipe is buried, generally at depths of 3ft. to 4ft., instead of 18in. to 2ft.

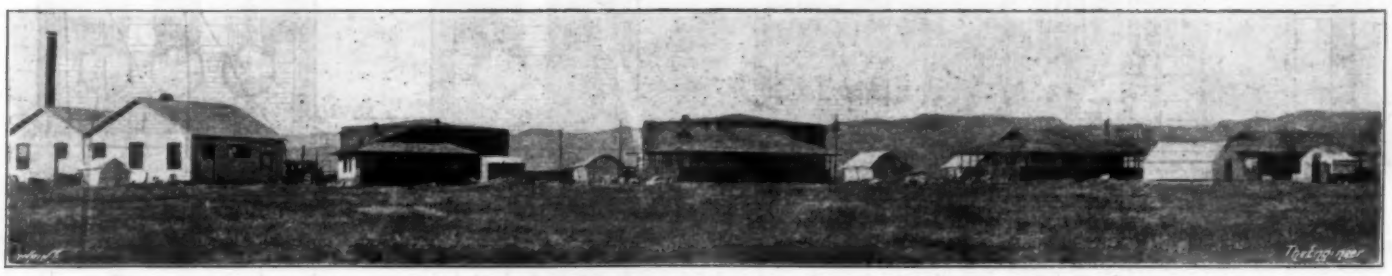


FIG. 8—PUMPING STATION FOR AN OIL PIPE-LINE IN CALIFORNIA

On the Coalinga pipe line there are eleven pumping stations, each designed to handle 25,000 barrels of oil in twenty-four hours at a pressure of 800 lb. in the mains. It has been mentioned above that the average spacing of pumping stations on the pipe lines in California is 13 miles, but on this particular line the distance was increased to 15 miles by the adoption of two sizes of pipe. The oil heated at the station is forced through an 8in. pipe for the first ten miles.

* No. II. appeared September 30th.

At that distance the temperature of the oil has fallen and its viscosity increased materially. To compensate for this choking condition the last five miles of the distance are laid with 10in. pipes. The increased pumping distance had the effect of eliminating two pumping stations, with a saving of about £60,000. Against this saving there is an excess charge of £10,000 for 10in. instead of 8in. pipe, leaving a net saving in cost of £50,000.

The main pumping engine at each station is a high-duty cross-compound Corliss engine of the crank and fly-wheel type, with cylinders 26in. by 36in. and 42in. by 36in., connected directly by cross yokes and

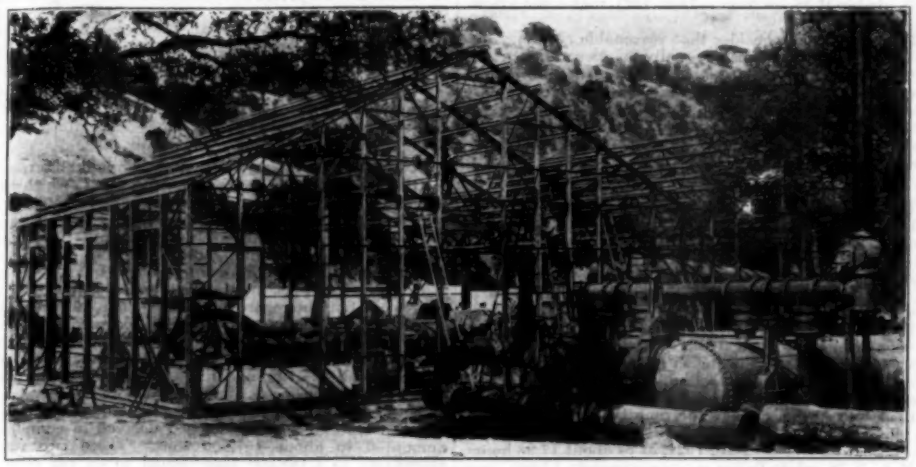


FIG. 10—PUMPING STATION BEING BUILT OVER MACHINERY ALREADY INSTALLED

side rods to an oil pump having four single-acting plungers 6¼in. by 36in., operating in cast steel cylinders. To each oil cylinder are bolted four double valve chambers, each containing an inlet and an outlet valve. The valves are of bronze, with ¼in. lift, and are fitted to double annular valve seats of crucible steel. The area of the openings is 18 square inches. A manifold connects the suction main from the oil tanks with the valve chambers, while two manifolds connect the discharge openings of these chambers with the pumping or force main. One of these engines, built by the Allis-Chalmers Manufacturing Company, of Milwaukee, U.S.A., is illustrated in Figs. 11 and 12, on page 400, which show the steam and oil ends respectively.

At each station there are two water-tube boilers of 250 horse-power each, as shown in Fig. 13, page 400, these boilers being fired with fuel oil and connected to a steel chimney 70ft. high. The auxiliary pumping engine—see Fig. 9 and 14—for use when the main pump is under repair, is a duplex compound double-acting engine having steam cylinders 16in. and 30in. by 24in. and 7½in. by 24in. oil cylinders with valves similar to those of the main engine. It can deliver from 12,000 to 15,000 barrels daily. The auxiliaries at the station include two vertical feed pumps 10in. and 7in. by 18in., a hot well pump 6in. by 5in. by 10in., and a general utility pump of the same size for charging the fuel oil tanks, returning oil drips and similar work.

The pump and tank equipment for all the pumping stations includes twenty-two water-tube boilers of 250 horse-power each, eleven main pumping engines for 1200 barrels per hour, eleven auxiliary pumping engines for 600 barrels per hour, twenty oil tanks each of 37,500 barrels capacity, and eleven water tanks of 1200 barrels capacity. The buildings are of steel frame construction. At each station there is the pump or engine house, three cottages, a dormitory, two wells with an elevated tank for the water supply, and engine-driven electric light plant, a motor-driven ice-making machine, and a small gas machine. Two oil storage tanks of 37,500 barrels capacity are connected to the discharge end of one section of the pipe line and the suction end of the next section, one of these tanks being for reserve or extra storage. There are also two tanks of 100 barrels capacity for measuring and storing oil for the use of the station and a 1200-barrel tank for feed water.

One of the completed stations is shown in Fig. 8. At the left are the engine house and pump house adjacent to the two large storage tanks. In the middle and at the right are four of the permanent buildings, the white buildings being the tents of the construction camp.

Most of the pumping stations of the Coalinga line are in desert country, as indicated by Fig. 8, and their construction was carried out according to a regular programme. In the first place, a "pioneer gang" went from site to site establishing the tents and camp quarters. This gang was followed by a "concrete gang" which placed the concrete foundations for the buildings and machinery. Next followed a "steel gang," which set the boilers and some of the heavy machinery in place before erecting the structural steel framework of the buildings, as shown in Fig. 10. This gang also placed the steel chimney and the steel tower for the elevated water tank, the tank itself being erected by a contractor.

A smaller "steel gang" then followed to apply the corrugated metal sheathing, the roofs and the steel sash work, a glazier with this gang putting in the glass. Next came a large "machinist gang" of engineers, which set up the main and auxiliary pumping engines, the station foreman and his helpers doing most of the lighter work on the small pumps, miscellaneous equipment and steam piping. An operating engineer with a small gang then got up steam, adjusted the valves, turned over the engines and made the plant ready to be put in service. Finally, a "clean-up gang," composed of men of different trades, attended to minor details.

Scientific and Industrial Research.

No. I.

The sixth annual report of the Committee of the Privy Council for Scientific and Industrial Research, covering the period from August 1st, 1920, to July 31st, 1921, was published at the end of last week. We reprint it in full below, and in next week's issue hope to give extracts from the technical report of the Advisory Council, which, as usual, is appended to the Committee's report.

During the past year, the most important development in the work of the Department has been that connected with the new boards to which we referred in our last annual report. These boards have been established as the result of a Government decision to co-ordinate, in the interests of economy, researches which are of civilian interest as well as of importance to the fighting services, and to direct the expenditure of funds provided in the estimates of the Department for the development of research for Government purposes. The work of the boards has been initiated in a difficult period. In view of the Government instructions with regard to the restriction of public expenditure, it has been necessary to proceed with caution in expenditure on new researches and, in view of the difficulty of securing research workers of high qualifications and of introducing a new and experimental system of co-operation between different departments of State, the progress has inevitably been slower than will be the case after experience has been gained and time has been given for working out a well-considered programme. We do not consider that this is wholly a matter for regret. The policy of co-ordination can only be carried out wisely if application be not unduly hurried. The first duty of the boards is to make such a survey of the existing research activities of Government, and to promote such an interchange of information, as will lay a sure basis for future progress. The results, so far as they have gone, have been decidedly encouraging, and we have every confidence that these boards will justify their establishment by promoting co-operation and a free interchange of information, and thus lead to the economy of effort and expenditure the Government desire to effect.

In view of the urgent necessity for restricting public expenditure, the estimates for the current financial year had to be drawn up within definite limits. We desire to record our appreciation of the assistance we received from our Advisory Council in securing that the sum available should be applied to those researches on which its expenditure would prove most advantageous under existing conditions.

In addition to the limitation of the estimates for the current financial year, we have caused to be prepared, in accordance with Government instructions set out in Treasury circular of May 13th last, preliminary estimates for the financial year 1922–23 showing a saving of 20 per cent. of the estimates of the current year. In the preparation of these estimates we again received valuable assistance from our Advisory Council, who submitted a report indicating the manner in which, if this reduction must be made, the requisite saving may be effected with the minimum of harm.

The curtailment of the resources at our disposal, due to the financial position of the country, is causing us and our Advisory Council very great anxiety. As the Council points out in its report, the limitation which has already been imposed on the expenditure of the Department will inevitably involve the postponement of a certain amount of research work which we consider of importance in the national interest, while over the whole programme of work of the Department its effect will be to retard progress and to delay the stage at which results will become available.

In our last report we referred to the establishment of a Building (Materials and Construction) Research Board, under the chairmanship of the Marquess of Salisbury. This Board began work before the beginning of the year under review in this report, and to enable the work to be carried out economically and efficiently, we have arranged for the provision, on a site furnished by the Acton Urban District Council, of temporary premises for use as a Building Research Station. The expenditure of the Board during the financial year 1920–21 amounted to £5898 2s. 1d. In the estimates for 1921–22 we have made provision for an expenditure of £14,202 on the work of this Board, including a sum of about £3000 for the Building Research Station.

The extension of the programme of the Geological Survey and Museum, to which we referred in our last report, has now begun to take shape under the management of the Geological Survey Board, and the work will be further extended in the early future so as to enable the Survey to meet more fully the need for further geological information about mining areas. The expenditure on the Survey and Museum during 1920–21 amounted to £43,784 4s. 11d. During the current financial year the estimates of the Geological Survey make provision for £12,000 in respect of expenditure in the printing establishment of the Ordnance Survey on the engraving and printing of Geological Survey maps, in accordance with the decision that this service shall in future be rendered by the Ordnance Survey on a repayment basis. This decision is responsible for a substantial increase in the estimates of the Survey additional to that resulting from the extension of the work. The estimated expenditure on the Survey and Museum in 1921–22 is £65,711.

Important work has been undertaken during the year by the Fuel Research Board.

A long series of experiments on the effect of steaming various coals in vertical gas retorts has been completed and a report issued. The results show broadly that substantial gains can be made in the gas evolved, and also in the by-products, tar and sulphate of ammonia. A report will shortly be issued dealing with the experiments on low temperature carbonisation and the carbonisation of air-dried peat at various temperatures. Inquiries have been prosecuted in Canada in connection with peat winning, and experimental work has been carried out in Ireland at Turraun. Research work on power alcohol has also proceeded actively.

The expenditure on the Fuel Research Station during 1920–21 was £40,889 0s. 3d.; the receipts from the sale of by-products amounted to £3196 17s. 10d. The expenditure on the work of the Board elsewhere than at the Fuel Research Station amounted to £3683 13s. 2d. We have made provision in the estimates for 1921–22 for an expenditure of £54,979 on the Fuel Research Station, with receipts estimated at £6600. The expenditure elsewhere than at the Fuel Research Station we have estimated at £7985.

The expenditure of the National Physical Laboratory has, during the past year, moved increasingly in the direction of the permanent conditions which will obtain now that the war activities of the Laboratory have been completed. The total expenditure on the Laboratory during 1920–21 was £203,865 14s. 5d., and the receipts amounted to £45,770 11s. An important alteration has been made in the form of the estimates of the Laboratory for the current financial year. It has been arranged that, where one of the fighting services uses the facilities of the National Physical Laboratory for research work which does not fall within the scope of one of the co-ordinating boards of the Department, the work must be undertaken on a repayment basis. Consequently, the receipts of the Department in the present and in future estimates will be increased by the amount to be paid to the Department by the fighting services in respect of work undertaken for them directly by the National Physical Laboratory; the net vote of this Department will be correspondingly reduced and the net charge of the Civil Vote in respect of research will be more correct. The total estimated expenditure of the Laboratory in 1921–22 is £213,269, and the estimated receipts amount to £101,000, of which £50,900 represents fees paid by outside bodies for tests and special investigations, while £50,100 represents research undertaken for other Departments of State on a repayment basis.

The most important development of the work of the Food Investigation Board during the past

year has been the establishment of the relations with the University of Cambridge referred to in our last report, and the decision to proceed with the erection of a Low Temperature Research Station on the site provided by the University in accordance with plans approved by the Board and ourselves. We have made a grant of £35,500 to the University for the erection and equipment of the Station. When the Station is complete we shall make provision for its maintenance in the estimates of the Department. Meanwhile, for the continuation of the present work of the Board we have included a sum of £23,318 in the estimates of the current financial year. The total expenditure during 1920–21 was £27,032 14s. 6d.

The Tin and Tungsten Research Board, having brought its labours to a definite stage, was dissolved at the end of 1920. The balance of the Tin and Tungsten Research Fund, which had been provided by the Cornish landowners and mine owners, then amounted to £393 8s. 6d. We have concurred in a proposal that this balance, after adjustment of certain expenditure on patents taken out to cover the results of research carried out by the Board, shall be transferred to the Cornish Chamber of Mines for the prosecution of research for the benefit of the tin-mining industry.

The Department has conducted work on thirteen other research programmes carried out under the supervision of various committees of the Department during 1920–21. The total expenditure on this work during the financial year was £12,881 13s. 6d.

The number of industrial research associations now approved by the Department is twenty-six. During the year ended March 31st, 1921, the total expenditure on grants to associations amounted to £74,557 1s. 2d. The balance of the Million Fund then remaining unexpended was £903,205 8s. 10d. Of this sum a large percentage has already been earmarked for prospective commitments to associations already formed.

The income provided by the interest on the unexpended balance of the Million Fund amounted during the year ended March 31st, 1921, to £51,889 4s. 11d. After applying £13,866 11s. 5d. to meet the cost of industrial research and certain other charges, the balance of £38,022 13s. 6d. was appropriated in aid of the Vote of the Department in accordance with the arrangement described in our report last year.

In addition to the Million Fund for research associations and the Tin and Tungsten Research Fund referred to above, the Imperial Trust holds certain other funds for research purposes. The balances of these funds appearing in the books of the Trust on March 31st, 1921, were as follows: the Williamson Trust, £620 17s. 5d.; various funds held in trust for the National Physical Laboratory, £5701 7s. 7d.; the Superannuation Trust Funds, representing accumulated contributions towards the superannuation of certain officers for whom we have not taken out insurance policies, amounting to £2457 1s. 11d.

Twenty-four applications for patents have been filed by the Imperial Trust in conjunction with the respective inventors during the past year, and, of these, five were not proceeded with. Four patents have been allowed to lapse by the non-payment of the renewal fees.

A statement of the progress made by the Inter-departmental Committee appointed to establish uniformity of procedure between Government Departments in dealing with the discoveries made by scientific workers aided or maintained by public funds is given in the report of our Advisory Council.

During the financial year 1920–21, we made eighteen grants in aid of scientific investigations conducted by other bodies, of which fifteen were in continuation of previous grants. The total expenditure on these grants amounted to £20,912 3s. 11d. We have made provision amounting to £8975 for their continuance during the current financial year. They are met partly from the Vote of the Department and partly from the interest of the Million Fund. The grant to the Imperial College for the Department of Aeronautics, for which provision was made temporarily in the estimates of the Department for the year ending March 31st last, is now provided under another vote, and is not included in these figures.

During the academic year 1920–21, we made 132 allowances to students to enable them to take advantage of the facilities for training in research offered by various universities and colleges. We made 70 grants to research workers to undertake independent research or act as scientific assistants to investigators of standing. In addition, we made 43 grants to scientific workers to enable them to employ laboratory or clerical assistants or to purchase equipment. The total expenditure on these grants during the academic year 1920–21 is estimated at £40,850, as compared with an expenditure of £23,655 5s. 9d. during the academic year 1919–20.

The expenditure out of the Vote of the Department during the financial year 1920–21 was £462,650 1s. 9d. This sum was made up of £373,821 7s. 2d. from the Exchequer, £38,022 13s. 6d. from the interest of the Million Fund, and £50,806 1s. 1d. from fees for tests, &c. It does not include the payment of £74,557 1s. 2d. from the Million Fund, the £13,866 11s. 5d. referred to above, or a payment of £1145 13s. 4d., which was recovered from the Tin and Tungsten Fund. The total expenditure of the Department was therefore £552,219 7s. 5d.

During the past year Professor J. B. Farmer, F.R.S., and Sir John F. C. Snell, M. Inst. C.E., have been added to our Advisory Council, which thus consists of twelve members in addition to the chairman, Sir William McCormick. We desire to record our thanks to the Advisory Council for their valuable services during the year.

The Loss of the R 38.

The Air Ministry, in publishing the appended report of the Court of Inquiry into the circumstances of the loss of H.M. airship R 38, on August 24th, 1921, makes the following statement:—

The Air Council consider that reasonable certainty has been reached as to what actually happened when the accident took place and as to the sequence of events. They are, however, of the opinion that judgment must be suspended on the further points raised by the report until the work of investigation by the Aeronautical Research Committee, which has already begun, is concluded.

REPORT.

The terms of reference of the Court of Inquiry were as follows:—"By command of the Air Council, a Court of Inquiry will assemble at R.A.F. Airship Base, Howden, at 10.00 hours on Saturday, August 27th, 1921, to inquire into the circumstances occasioning the loss of H.M.A. R 38 on August 24th, 1921, and to express an opinion as to possible causes of the loss."

The Court, having considered the evidence and the terms of reference, have reached the following conclusions, but wish to point out that owing to the illness of the captain of the ship—Flight-Lieutenant A. H. Wann, R.A.F.—they have been unable to procure his evidence. It is not anticipated, however, that the opinion given below will be modified to any appreciable extent:—

(*a*) That on August 24th, 1921, at or about 17.38 hours, H.M.A. R 38, while flying at approximately 1200ft. over the Humber in the neighbourhood of Hull, broke in two parts, due to failure of the structure in rear of the after engine cars, when being subjected to control tests.

(*b*) That immediately after the fracture a fire broke out in the forward portion, and this was mainly responsible for the large loss of life.

(*c*) That these control tests were being undertaken with a view to determining the airworthiness of the ship.

The sequence of the events as disclosed by evidence is as follows:—

That the airship, having completed some thirty hours' trial, including fifteen minutes at full speed—60 knots—was flying at a height of about 1200ft. She was carrying out rudder and elevator tests at a speed of 45 to 50 knots. Almost extreme helm with a quick reversal was being used, which brought a heavy force on the after portion of the hull, due to the swing of the stern.

During this manœuvre the structure failed between frames 9 and 10, the first indication of which to ground observation was a slackness of the fabric at this point.

The ship then broke into two portions. The forward portion caught fire at the fracture at the moment of or shortly after separation.

The fire probably originated in a spark from the electric leads, which became fractured at a point in the immediate vicinity of a similar fracture in the petrol mains. As all sources of electrical energy were situated in the forward portion only, the rear portion was not affected, as electric leads in the latter portion became dead immediately the fracture took place.

The fire in the forward portion spread rapidly, due to the presence of escaping petrol in the keel. An explosion followed, which led to the collapse of the structure and the ignition of the liberated hydrogen gas. A second explosion took place when the forward portion reached the water. Meanwhile the after portion descended comparatively slowly, but did not catch fire. Four of the five survivors were in this portion and were rescued uninjured.

The Court wish to bring the following points to notice:—

1. That H.M.A. R 38 was designed in August, 1918, in the Department of Airship Production, Admiralty, to meet requirements which appear to the Court to be greatly in advance of those of previous British airships.

That the requirements as to maximum height and speed, together with the limits in length imposed by the only available construction sheds, necessitated the utmost economy in hull weights and materials. Many new features were introduced in the design, and it appears evident that in some cases there was a lack of vital aerodynamical information as to the effect of these modifications on the strength of the structure.

That the first frames of the ship were completed in October, 1919, at Cardington by Messrs. Short Bros., and in the same month the Airship Department was transferred from the Admiralty to the Air Ministry. Cardington was taken over from Messrs. Short Bros. in April, 1920, by the Air Ministry, and became the Royal Airship Works.

2. That having regard to the great differences in the requirements between H.M.A. R 38 and previous British airships, the design should have been examined and discussed by an official and competent committee before actual construction was commenced. There is no evidence to show that this has been done, although opportunity arose after the Armistice when information as to the details of ships built elsewhere became available.

3. That the system by which both the construction of the ship and the inspection of the work are centred in one head, as was the case at the Royal Airship Works, Cardington, is unsound.

4. That although there can be no doubt that efforts were made towards the end to complete the ship in the shortest possible time, there is no evidence that the work on the hull structure suffered.

5. That one parachute was provided for every person on board.

That the total complement numbered forty-nine.

No survivor owed his escape to a parachute, though evidence shows that at least one parachute descended with two men below it, but they were not amongst the survivors.

The general break up and rapid spread of the fire in the keel prevented the more successful use of these appliances.

6. That no bombs or other high explosives were being carried.

7. That the weather during the whole flight was calm.

The Secretary of the Admiralty communicates the following:—

With reference to the report of the Court of Inquiry into the circumstances occasioning the loss of H.M. airship R 38 and the Air Council's statement thereon, the Admiralty are conducting a full investigation into the history of the design of the airship and of the initial stages of its construction up to October, 1919, when responsibility for the design and construction of airships was transferred to the Air Ministry, and the result of this investigation will be published in due course.

Lloyd's Register Shipbuilding Returns.

According to Lloyd's Register shipbuilding returns for the quarter ended September 30th, 1921, which have just been published, the merchant tonnage under construction in the United Kingdom at the end of September, 1921, amounted to 3,282,972 tons. This, it is explained, represents a reduction of about 247,000 tons as compared with the total at the end of the previous quarter, though it is remarked that, under the present conditions, the figures can only be regarded to a large extent as nominal. As in the previous quarter, the total included a considerable amount of tonnage on which work had been suspended owing to the decline in the demand for tonnage, and also a large quantity of tonnage the completion of which had been postponed owing to abnormal causes. The tonnage on which work had been suspended amounted to 731,000 tons and the tonnage which had been delayed in completion amounted to about 457,000 tons. These two totals, amounting to 1,188,000 tons—equal to 36 per cent. of the whole of the tonnage under construction—must be deducted in order to enable a comparison to be made with the figures for normal times, and a reduced total of 2,095,000 tons under construction in the United Kingdom is thus arrived at. As compared with the figures for the quarter ended June 30th, 1921, there was a reduction of about 14,000 tons in the tonnage launched during the past quarter.

Attention was called in recent quarterly returns to the fact that, although the total tonnage returned as under construction was so large, the amount completed compared very unfavourably with pre-war times. In 1913 the average tonnage completed during each quarter was over 23 per cent. of the total work in hand at the beginning of the quarter. The corresponding figures for 1920 fell below 13 per cent., and there was still a further reduction during 1921, the average output for the first three quarters having fallen as low as 8½ per cent. There was a continued reduction in the tonnage commenced. In the March quarter the decrease amounted to 113,000 tons, in the June quarter there was a further reduction of 324,000 tons, and for the quarter under review the tonnage commenced only amounted to 51,343 tons, or a decrease of 455,000 tons as compared with the last quarter of 1920. This is perhaps the most significant figure in the return as indicating the very unfavourable outlook for the immediate future.

The total merchant tonnage being built abroad is 2,260,006 tons, but the figure includes about 375,000 tons—equal to 16.6 per cent. of the total—upon which work has been suspended, leaving 1,885,000 tons actually under construction. The countries in which the largest amount of work is suspended are Italy and the United States. The tonnage is about 409,000 tons lower than the total being built at the end of June, 1921, the fall being largely due to the continued decrease in the United States of America, in which country the tonnage now under construction is less than 10.5 per cent. of the total being built there in March, 1919. Apart from the United States, the leading countries abroad are:—Italy, with 397,544 tons; France, 350,681 tons; Holland, 349,122 tons; and Japan, 186,782 tons. The total for Italy shows an increase of about 87,000 tons as compared with the previous quarter, but, as stated above, the total includes a very considerable tonnage on which work is now suspended.

The returns show that there are at the present time 140 steamers and motor vessels, each of over 1000 tons, with a total tonnage of 931,813 tons, for the carriage of oil in bulk, under construction in the world. Of the total, 81 of 527,791 tons are under construction in the United Kingdom, and 28 of 222,292 tons in the United States. The tonnage of vessels under construction which are to be fitted with internal combustion engines amounts to 405,941 tons.

The tonnage being built in the world at the end of September under the inspection of the surveyors of Lloyd's Register, excluding vessels the construction of which has not actually been commenced and excluding all vessels of less than 100 tons, amounted to 3,785,589 tons.

THE JUNIOR INSTITUTION OF ENGINEERS.—A local section of the Junior Institution of Engineers was successfully inaugurated at Loughborough, Leicestershire, on Wednesday, October 5th. The President, Lord Weir of Eastwood, took the chair at the opening meeting, which was held at the Town Hall, the chairman of the Institution and other officers from headquarters being present. There was a large attendance of engineers of all ages. The resolution that the section be established was put by the chairman, and carried unanimously. Lord Weir then inducted Mr. H. Schofield, Principal of Loughborough Technical College, as the first chairman of the section, which will have its headquarters at the College, a meeting room and equipment having generously been provided by the Governors. The members already elected comprise several of the masters and engineering students of the College, besides engineers engaged in works in Loughborough and the neighbouring towns of Leicester, Derby and Nottingham. Persons resident in the district desiring further information should apply to the local hon. secretary, Mr. G. Mavor, The College, Loughborough, Leicester.

A Seven-Day Journal.

Prince of Wales and Unemployment.

It is hoped that there will be a generous response to the practical suggestion made by the Prince of Wales at the Mansion House on Wednesday that a sum of £1,000,000 should be guaranteed for the British Empire Exhibition, and work on construction and other preparatory operations put in hand at once to provide employment. The argument is that if the Exhibition is to portray the resources of the Empire on the requisite scale, no time should be lost in making a start is a sound one, and it is felt that the appeal to banking, commercial and industrial interests to guarantee the sum named is not one which can be lightly disregarded. The Prince reminded his distinguished audience in the City of London that the Dominions were accepting their share of financial responsibility, and it would indeed, as he intimated, be a sorry thing if the great heart of the Empire could not also do its share.

New Type of Aeroplane Wing.

The tests of the "Alula" high-lift wing, which took place on the Northolt Aerodrome on Wednesday, were watched by a company, which included many experts, with great interest. The machine to which the wing was fitted was a Martynside Semiquaver fuselage, fitted with a 300 horse-power Hispano-Suiza engine. The wings are designed on the cantilever principle, and do not require external bracing wires. This form is of a type designed to secure the flow of air parallel to the direction of flight, with the object of eliminating the losses arising from "spilling," which are associated with the more normal type of wing. The loading of the machine, which exceeded 19 lb. per foot of surface, was exceptionally high. The trials must be regarded as successful, an altitude of 3000ft. being attained in 72 sec., and the machine reaching an air speed of 180 miles per hour. It is claimed that the wing can be fitted to all classes of aeroplanes, although the original intention was to apply it to low-speed big load-carrying machines.

Shipbuilding and Engineering Wages.

As a result of fresh negotiations in London and Edinburgh between the Engineering and Shipbuilding Employers' Federations on the subject of the withdrawal of the 12½ and 7½ per cent. Ministry of Munitions bonuses employers made an offer to effect the withdrawal by equal monthly instalments, to come into operation on November 1st, December 1st, and January 1st next. The representatives of the men have agreed to submit this proposal to a ballot, and although it is understood that no definite recommendation for acceptance will be made with trade union leaders, there is a widespread belief that having regard to the depressed state of the shipbuilding and engineering industries, the offer of the employers will be accepted. It was stated on the occasion of the Edinburgh meeting of the shipbuilding industry at which these terms were put forward, that over 90 per cent. of British shipbuilders were now engaged on the last order on their books, and that new contracts could not be obtained even by tenders which eliminated all chance of profit to the shipbuilder.

Iron and Steel Output.

The figures which have been issued of the iron and steel output for the past month reveal a slight but welcome improvement in the pig iron position. The production of pig iron for September was about 150,000 tons, as compared with 94,000 tons in August, but in September, 1920, the output was 740,000 tons. The production of steel, however, showed a falling off last month, as compared with August, of 9000 tons, the actual figure being 425,000 tons, which is only 50 per cent. of the production for the corresponding month of last year. Imports of pig iron remain on a high scale, being 121,000 tons for September, as against a normal average of 18,000 tons a month, while exports of pig iron declined to 7000 tons last month, whereas in the pre-war period the normal rate of exports was 100,000 tons a month.

Conference of Engineering Industry.

The decision by the executive of the British Engineers' Association to convene a conference of its members to consider means of restoring vitality to the engineering industries is an excellent move. It is only by concerted action that the trades concerned can hope to live through the present difficult period, and Mr. E. W. Petter, the chairman of the Association, has expressed the hope that some practical proposals will emanate from the conference. It is quite clear that, as was pointed out by Mr. Hichens at the meeting of the London Iron and Steel Exchange a few days ago, whatever may be done by the Government to assist industry, the main task of overcoming the present difficulties must be undertaken by those practically engaged in industry and commerce, and be a co-operative effort by both employers and employed. Mr. Petter disagrees with the suggestion that inflation is the main cause of the present serious financial situation, and believes that relief would come if the policy of deflation were held in abeyance for the time being. The effect of such an announcement would, he suggests, be to cause a hardening of prices, bring buyers again into the market, and set the clogged wheels of industry again in revolution. Our relative position towards France and other countries with depreciated exchange would, it is argued, tend to improve if the process of deflation were retarded. It is quite clear that, judged by the decisive test of its effect on the employment and earnings of the people and on the capital invested in industry, the present economic policy has been pressed too far, and that the brake should now be applied.

French Canal Improvements.

It is announced from Paris that the Minister of Public Works has submitted for the approval of the President an important programme for the improvement of French waterways. One scheme is for the widening and deepening of the canal linking the Marne with the Rhine navigation, for the canalisation of the Moselle from Metz to below Thionville, and for a canal in the Sarre basin. It is pointed out that canalisation of the Moselle would have been carried out long since but for the fact that Alsace-Lorraine has been in German possession for so many years. There is a large coal traffic from the Sarre basin, which, it is believed, would justify the construction of the proposed canal. The cost of these various works is estimated at 465,000,000f. Another scheme is for the improvement of the Berri, Nivernais, Midi and Garonne canals at a cost of 270,000,000f. These canal projects are part of a programme of development which includes not only inland waterways and ports, but railways, hydraulic power and electric supply.

Design of R 38.

The preliminary report of the court of inquiry into the loss of the airship R 38, which has been issued by the Air Ministry, tends to confirm suspicions which had been entertained in many quarters. It is stated that the airship was designed to meet requirements greatly in advance of those of previous British airships, and that these requirements, particularly as regards maximum height and speed, together with the limits in length imposed by shed accommodation available, necessitated the utmost economy in hull weights and materials. Many new features were therefore introduced in the design, and it is clear that in some cases there was a lack of vital aero-dynamical information as to the effect of these modifications on the strength of the structure. The opinion is therefore expressed that the design should have been examined and discussed by a competent official committee before construction was commenced. There is no evidence to show that this was done, although information was available immediately after the Armistice with regard to the details of German airship design. It is added that the Admiralty are conducting a full investigation into the history of the design of the airship and of the initial stages of its construction up to the date when the responsibility was transferred to the Air Ministry. The result of this inquiry will be made public in due course.

Presentation to Professor Philip.

A pleasant little gathering, which was presided over by Sir Richard Gregory, took place at the Imperial College Union on Tuesday evening last, when, on the completion of twenty-one years of service as Professor of Physical Chemistry at the Royal College of Science, Professor J. C. Philip was presented with an illuminated address and other tokens of esteem from past and present students. Sir William Tilden made the presentation in felicitous terms, and reminded the gathering that this was not a retiring presentation, as Professor Philip would, it was hoped, continue to carry on his work for many years to come.

London University Site.

Those who are advocating the adoption of the Holland Park in preference to the Bloomsbury site for the extension of London University are still prosecuting their campaign. At the meeting of the Senate of the University on Wednesday next a letter will be laid on the table from the London County Council asking that the claims of the Holland Park estate should be thoroughly examined before any further steps are taken to carry out the Bloomsbury scheme of extension. It is pointed out that the Holland Park site is not only larger and possessed of more natural amenities than the Bloomsbury site, but can be acquired at a much lower price. The situation is complicated by the fact that the Government has acquired the Bloomsbury site at a cost of £425,000, and that the Senate of the University has accepted this site, partly in the belief that the London County Council would make a large grant up to £333,000 in the event of the Senate deciding to make extensions at Bloomsbury. The subject will be discussed at next week's meeting of the Senate, but it is difficult to see how a change can now be made.

London-Paris Air Services.

Although the Instone Air Line has accepted the Government subsidy for the maintenance of services between London and Paris, it is stated by Sir Samuel Instone that heavy losses are certain to be incurred, as the Government conditions will not enable British companies to offer effective competition to the heavily subsidised French air lines. Sir Samuel criticises the Government for its failure to give the necessary support to the civil side of British aviation, which would constitute a most valuable reserve of the Royal Air Force. In his opinion, a great mistake has been made in appointing too many firms to carry on the French service, as there is barely enough traffic to enable one, or at the most two, British companies to operate at a profit. It is suggested that until those engaged on the technical side of the industry have evolved the best type of commercial aeroplane, European air services must continue to be subsidised. Support must also, it is argued, be given to those engaged on aircraft design and construction, so that the type of machine required for commercial work, which it is believed will be an improved amphibian machine, can be evolved.

Smoke Pollution in London.

Some interesting facts are disclosed in the annual report of Dr. W. J. Howarth, the Medical Officer of Health for the City of London. The question of smoke pollution is discussed at considerable length in connection with the regular observations and measurements which have been carried out since the year 1914 in conjunction with the Committee for the Investigation of Atmospheric Pollution. The apparatus is designed to collect the rain water monthly from a known area of surface, and this rain water is submitted for examination to the public analyst and the result tabulated. It is shown that in a single month the amount of deposit registered as falling in the City of London amounted to 18.33 tons per square kilometre, equivalent to 47 tons over the whole of the City area of 1 square mile. Of this mass of dirt, 23.75 tons were soluble, and included sulphate, chlorine and ammonia. Daily observation has been made at Guildhall mid-day of the purity of the air by a modern dry method, and the statistics show that the amount of impurity at noon has varied from half a milligramme to 6 milligrammes per cubic metre of air.

Public Authorities and Foreign Contracts.

Several important public bodies have been placed in a somewhat difficult situation when tenders have been called for supplies of engineering materials owing to the low prices quoted by foreign firms. It is common knowledge that in one or two cases foreign tenders have been accepted, particularly for electric generating plant. A Swiss firm is supplying the generating sets for the new station at Edinburgh, and the London County Council has placed a contract with a Swiss firm for a turbo-generator set. The economic effect of the action of the London County Council is discussed in the current issue of the *Bulletin* of the British Engineers' Association by Mr. D. A. Bremner. He points out that on the assumption that 80 per cent. of the British price were paid in wages at all stages of manufacture, these would amount to £40,000 and employ 324 workpeople at an average weekly wage of £4 15s. for six months. If these people remain unemployed they would have to receive from one public source or another at least 20s. per week, which would absorb considerably more than the total saving effected by placing the contract abroad.

A Plea for Underground Roads.

Advantage was taken by Lord Ashfield of the presence at the annual dinner of the Institute of Transport of a large number of transport experts to argue the case for the development of road and railway traffic side by side. The belief was expressed that in the comparatively near future it would be necessary to construct not only additional underground railways in congested areas, but a system of underground roads. Lord Ashfield looks forward to the provision of roads designed for the use, not only of single-motor vehicles, but of motor vehicles operating in trains.

The Shipping and Engineering Exhibition.

No. VI.*

Electric Welding.

There was an exceptionally good collection of welding machines on the stand of the A-I Manufacturing Company, of Bradford. Two seam welders similar to those shown in Figs. 60 and 61 were exhibited, the former being designed for welding longitudinal seams and the latter for circumferential seams. Both machines are provided with ingenious jigs for holding the drum parts rigidly in position so as to ensure uniform results. The jigs can be changed to accommodate various sizes of drums, and in the operation of the machine the human element is practically eliminated. Drums made on these machines have been corrugated and tested under pressure, and they have stood up to all the requirements. A special interrupter switch fitted to these machines is claimed to make it possible to seam-weld heavy gauge metal at a speed which at one time appeared altogether impracticable. There were also two of the firm's electric rivet heaters, a portable shop type machine—see Fig. 62—and a heater which can be slung overhead. The former can be drawn along the floor to any desired position, whilst the latter can be slung so that it can be used for heating rivets in position, as, for example, rivets placed in the holes of a car chassis. The rivets which are heated in the portable machine shown are simply placed between the electrodes to be seen on the front of the heater when the passage of the heavy low-voltage current through the rivets rapidly raises the metal to a red heat. No cut-off switch is needed on these machines, for, as a cold rivet is placed in position before the hot rivet is removed, the circuit is never broken whilst the machine is at work. Among the butt welders exhibited was an automatic machine for welding small wires, saws and similar articles. The special advantages of this welder are that it works with great rapidity, its action is automatic, and articles can be annealed as they leave the machine. Another and larger machine specially designed for such work as cycle rim welding was shown; also a butt welder for dealing with brass tubes and so forth. There were two of the company's spot welders, a machine designed for light repetition work, such as hollow-ware work, and a machine capable of welding sheet metal of varying thicknesses up to ⅛in. added thickness.

Table I.

Electrode.	Grammes per Board of Trade unit on mains.	Open circuit volts.
No. 10 P	254	52
No. 8 P	315	52
No. 10 S	351	42
No. 8 S	356	42

Davies and Soames, Limited, were showing their low-tension alternating-current arc welder, as described in The Engineer of May 6th of this year. Tests made with this welder are said to have shown that with a Board of Trade unit it will deposit twice as much metal as a motor generator driven from direct-current mains, and consequently for each pound of metal deposited, the cost of the electrical energy is halved. The following tables give the actual results obtained from these tests, the figures given in Table I. referring to the "Daysohms" alternating-current welder and in Table II. to the direct-current motor generator set.

Table II.

Electrode.	Grammes per Board of Trade unit on mains.	Open circuit volts.
No. 10 P	118	60–80
No. 8 P	158	"
No. 10 I	150	"
No. 8 I	157	"

G. D. Peters and Co., Limited, of 3A, Dean's-yard, Westminster, were showing, among other things, several of their portable welding sets, one of which is illustrated in Fig. 63. The motor generator which supplies the welding current is flat compounded on the generator side and maintains a normal pressure of 35 volts at no load and full load. The control panel upon which the control gear is mounted is composed of slate, and measures 20in. by 27in. The control gear itself works on the well-known Wilson plastic arc system, and consists of a small carbon resistance pile, a spring to vary the pressure on the pile, and a solenoid. Three switches fitted to the panel provide an easy means of adjusting the current between 25 and 150 ampères. The welding circuit is arranged so that a current greater than 25 ampères never passes through the solenoid no matter whether the welding current is 25 ampères or 150 ampères, the excess current being in all cases passed through resistances shunted across the solenoid. The set can be supplied with a motor to suit the local supply, or to work as a petrol-driven unit, or the machine may be driven in any other manner. The normal speed of the generator is 1800 revolutions per minute. With an alternating-current motor the weight of the outfit is 807 lb., with a direct-current motor 800 lb., with

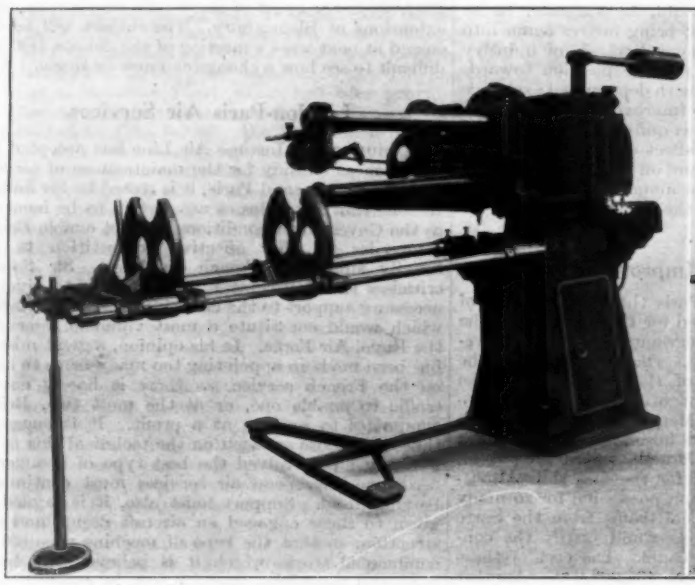


FIG. 60—LONGITUDINAL SEAM WELDER

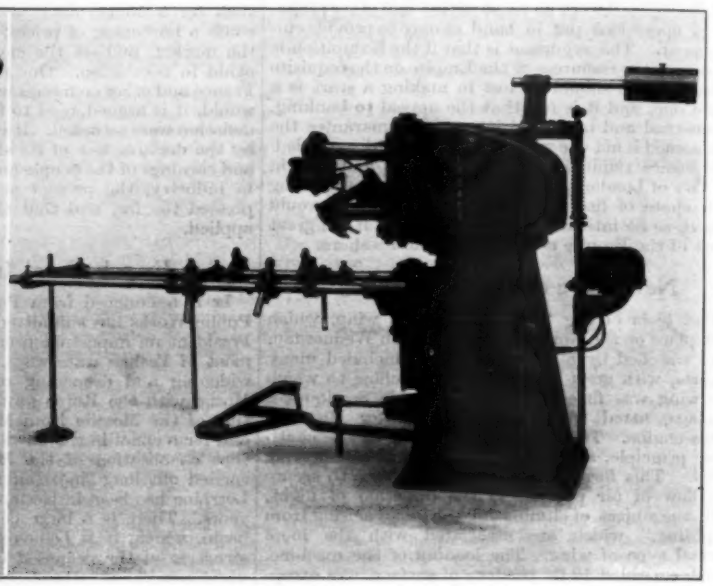


FIG. 61—CIRCUMFERENTIAL SEAM WELDER

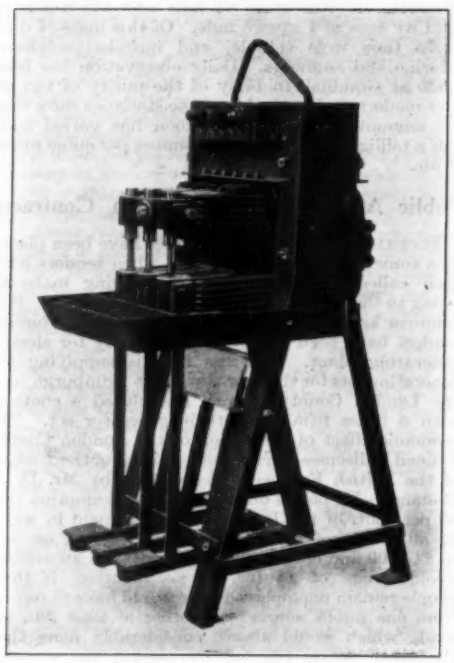


FIG. 62—RIVET HEATER

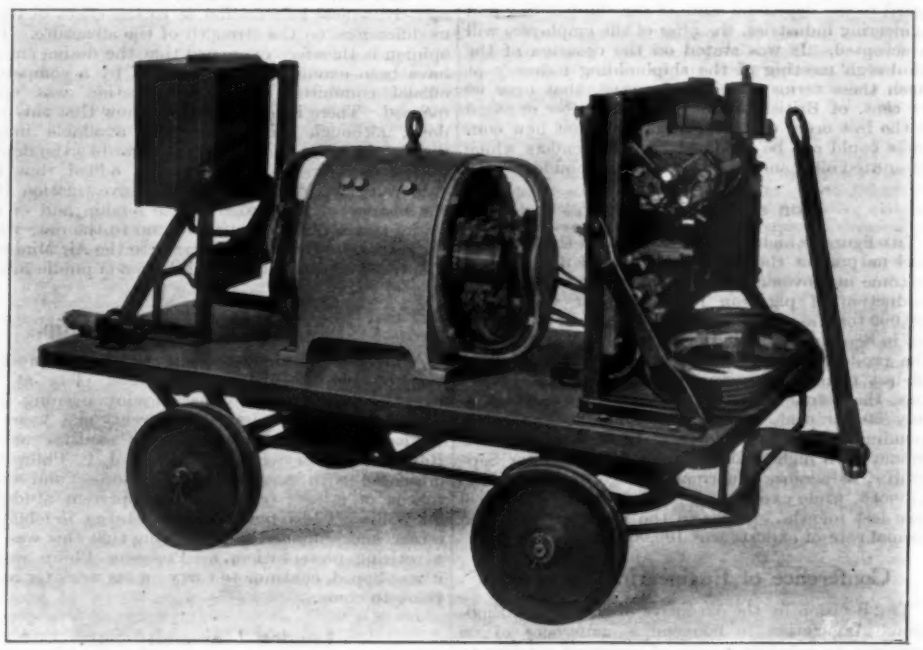


FIG. 63—PORTABLE ELECTRIC WELDING SET

* No. V. appeared October 7th.

a petrol engine 1200 lb., and with an independent belt drive 550 lb.

Switchgear.

Several distinct novelties in the form of switchgear were shown on the stand of the Heemaf Company of Holland, the London agents being Williams, Pell and Baring, of Regent-square. The most important exhibit was perhaps the desk switchboard shown in Figs. 64 and 65. This switchboard, which is intended for controlling a high-tension three-phase power station and which is built on the unit principle, can readily be extended to enable it to deal with additional generators or feeder circuits. It is constructed of steel plate panels with nickelled corners, and is provided with flush fitting instruments, control switches, regulators and indicators. The particular switchboard illustrated has been constructed for use in connection with an electrical installation in the Dutch West Indies, and is made up of two generator panels and a synchronising panel. On the table part of the desk there are push button switches for operating electrically actuated oil switches, indicating lamps and a synchronising plug, whilst on the lower panels there are shunt regulators for the exciters, and a regulator for adjusting the engine speed whilst synchronising. At the back of the desk there are integrating kilowatt-hour meters. The centre section is used for synchronising, and on the centre pillar there is a voltmeter, periodicity indicator, synchroscope, balance voltmeter, and a Heemaf automatic synchroniser, which synchronises the incoming generator automatically. On centre panel there is also a combined ammeter and voltmeter, relay switches and indicators and regulators for a small rotary converter which supplies continuous current to the auxiliary circuits which operate the oil switches. The principle upon which the automatic synchronism operates is simple. The synchroniser contains two aluminium discs, each provided with a pointer. One of the discs is subjected to the force of two specially shaped electromagnets, which produce a rotating magnetic field, the magnets being energised by the running and incoming machines. When synchronism is reached the two magnetic fields have a phase displacement of 90 deg., and subject the disc to the action of an increasing force, which is taken up by a spring which tends to bring the pointer of the disc back to its central position. When, however, the incoming machine is in phase with the machines already at work and the pointer reaches its extreme position it closes an auxiliary circuit, which in turn energises the various control circuits for operating the oil switch. The other pointer, which is attached to the second disc, simply acts as the pointer of a voltmeter and indicates the extent to which the voltage deviates from the normal. The two pointers can only meet when there is equality of phase and frequency and a difference in voltage not exceeding 10 per cent. It is said that when this instrument is used for synchronising, the angular phase displacement between the running and newly connected machine cannot exceed 7.4 per cent., which corresponds to a maximum current rush of 19 per cent., and this can only last during the time corresponding to from 1 to 3 cycles.

The three-pole oil switch shown in Fig. 66, which was inadvertently inserted in our last issue in connection with the description of the Igranic Company's auto-reclose circuit breaker, was another of this firm's exhibits. These switches are made in five sizes and suitable for voltages ranging 750 to 2400 and working currents of from 350 to 1500 ampères, the corresponding short-circuit currents being 1000 and 4500 ampères. The movable contacts are operated by a hand wheel, which, if necessary, can be actuated on the remote control system. Overload and no-volt release tripping gear can also be fitted. Signal lamps are also fitted if called for. The high-tension oil switch contacts are all enclosed in a welded steel tank liberally designed to withstand heavy short circuits. The knife-blade contacts are submerged in oil, and the live parts are carried on a porcelain base having high insulating properties. In all cases the switches have a positive and direct gravity break, and the movement of the contacts is assisted by springs. For all capacities below 1000 ampères the lid of the base is composed of cast iron, and for capacities of 100 ampères and over it is made of brass. Normally the switches are supplied without damping resistances, but they are fitted when called for. In the case of switches designed for currents up to 600 ampères all the contacts are placed under oil, but in the case of switches designed for heavier currents, only the arcing contacts are submerged, the main contacts being mounted on a substantial base on top of the switch, and the mechanism is so designed that the arcing contacts are opened a little after the main contacts.

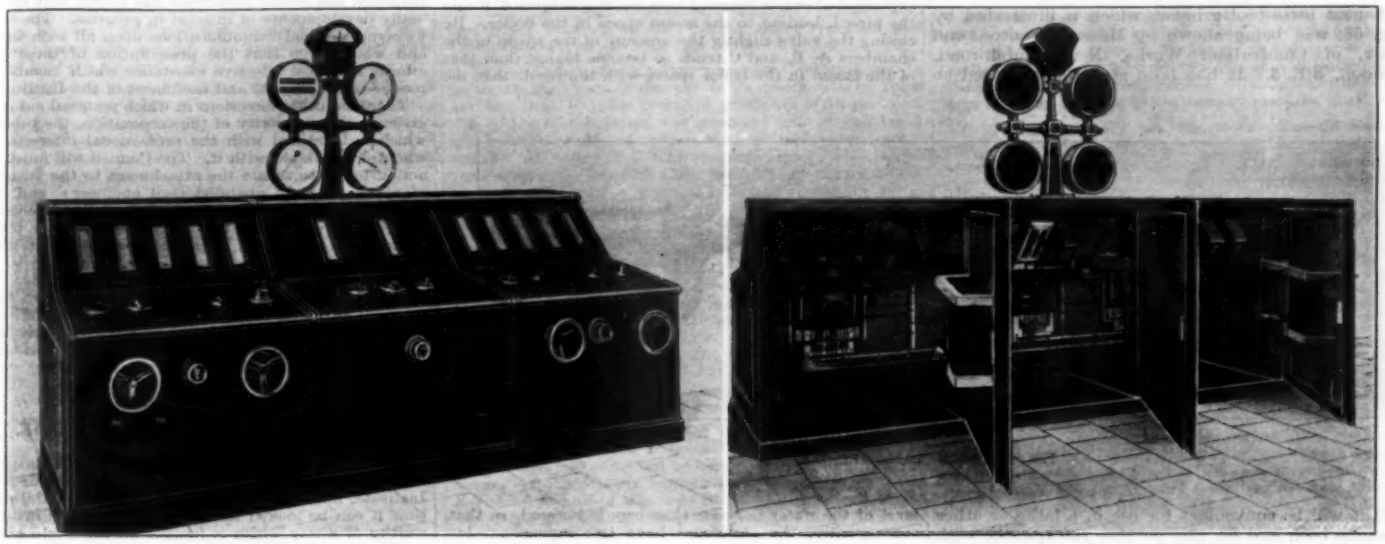


FIG. 64—DESK SWITCHBOARD

FIG. 65—BACK VIEW OF DESK SWITCHBOARD

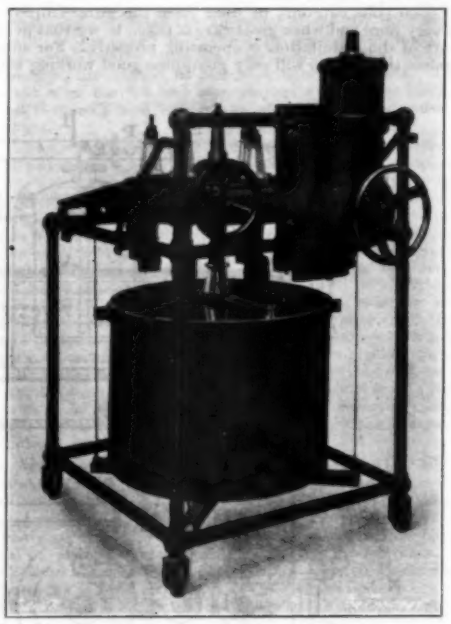


FIG. 66—THREE-POLE OIL SWITCH

The Igranic Electric Company's circuit breaker, which ought to have been illustrated in our last issue instead of the above three-pole switch, is shown in Fig. 67. The breaker opens and closes automatically according to the working conditions. When a short circuit occurs it opens in the ordinary way, but it will not close until the overload or short circuit has been removed. In all cases there is a definite interval between the time the breaker opens and closes, and this interval can be adjusted at will. When several circuit breakers are used in connection with a generator the adjustment becomes a valuable feature, as the various breakers can be set so that the supply circuits are connected up to the bus-bars in the proper sequence and the generator is able to pick up its load under the best conditions. In the event of the voltage failing, the breakers open automatically, and it will therefore be seen that full protection is given to the installation under all working conditions. The makers point out that when hand-closed circuit breakers are used and overloads are frequent there is a tendency for the switchboard attendant to set the trip far too high or to prevent it acting at all, but with this automatic reclose breaker the human element is entirely eliminated. Various automatic devices have been devised for use with these circuit breakers. For instance, in automatic sub-stations a thermostatic relay can be made to open the circuit breaker in the event of the bearings of the machinery getting hot. The breaker can also be opened by an over-speed device fitted to a rotary converter shaft, and various other special arrangements of this sort can be adopted.

Anti-corrosion Electrolytic Apparatus.

J. Downton and Co., Limited, of West India Dock-road, were exhibiting their electrolytic apparatus for preventing corrosion and the formation of scale in steam boilers, condensers, tanks, &c. The Gush anti-corrosive electrolytic system involves the use of a small low-tension direct-current which is supplied from secondary batteries or a motor generator, and is passed through iron anodes which are submerged beneath the water in the boiler or condenser or tank.

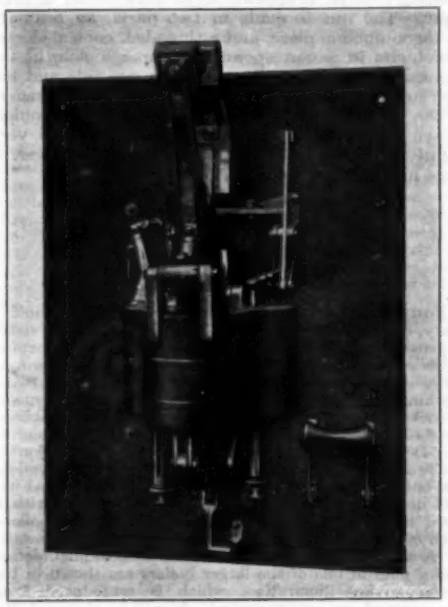


FIG. 67—IGRANIC AUTO RECLOSE CIRCUIT BREAKER

The anodes and the electrical connections must, of course, be properly insulated from the metal shell of the boiler or other arrangement. The water forms the electrolyte and passes the positive current on to the boiler shell, which becomes negative, the electric circuit being completed by earthing the negative pole of the supply and the metal shell. Stimulated corrosion of the anodes is brought about by making them the positive pole, and the surfaces are protected by chemical combinations taking place between the oxygen contained in the corrosion and scale forming impurities of the boiler water with the iron of the anodes. The special feature of the system, however, is the use of special "Morite" bolts, which serve for conveying the current to the anodes, for insulating the conductor and anodes from the boiler or condenser shell, and for mechanically supporting the

anodes in position. "Morite," which is the name of the material which insulates the bolts, is claimed to have extremely high insulating properties and to be admirably suited for electrolytic purposes. It can be turned in a lathe or can be machined so as to give it a perfectly flat face for making joints, its tensile strength is said to be practically equal to that of cast iron, and its texture is hard and tough, but not brittle, and it will withstand rough usage. It is also said to be unchanged when submerged in steam or water at all temperatures up to 500 deg. Fah., and is practically non-hygroscopic.

A Small Tool Grinder.

A neat little tool grinder, which is illustrated by Fig. 68, was being shown by Messrs. Brunton and Trier, of Cumberland Works, New Church-road, London, S.E. 5. It has been specially arranged so

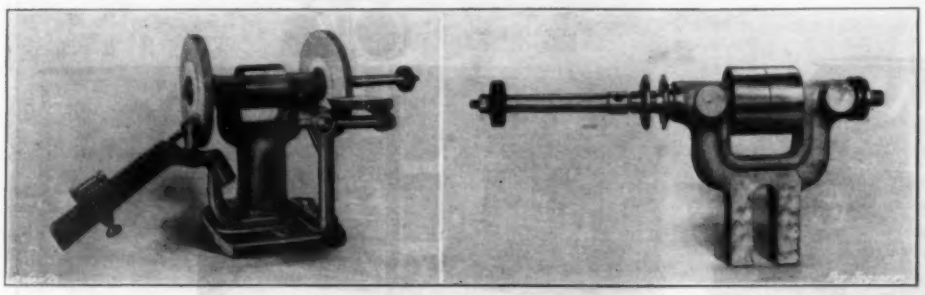


FIG. 68—SMALL TOOL GRINDER

that it will be convenient for use in a lathe or other machine tool, and for this purpose the spindle, with its bearings, can be removed from the stand. The illustration shows how the bearing casting has a forked extension, which fits into the pedestal and is secured by one bolt. The slot in the fork provides a convenient means of bolting the grinder in the tool rest of a lathe. The spindle bearings are of phosphor-bronze, and are split for taking up wear. A taper hole is bored up one end of the spindle to take an extension for internal boring. In connection with the pedestal there is a tool rest which can be tilted to any angle and a guide for grinding twist drills.

Lock Nuts.

A new form of lock nut was being shown on the stand of Mason, Page and Co., Boswell Works, Thornton Heath, London, and although we have not yet had an opportunity of thoroughly testing its holding powers, it appears to be very sound in principle. The nut is made in two parts, an ordinary hexagon outside piece, and a threaded, conical sleeve, which fits in a correspondingly tapered hole in the hexagon. The sleeve is split down one side and has two lugs which engage with recesses in the hexagon. When the nut is screwed down hard the conical sleeve is drawn into the outer part and binds very tightly on the bolt. At the same time, however, it does not injure the thread.

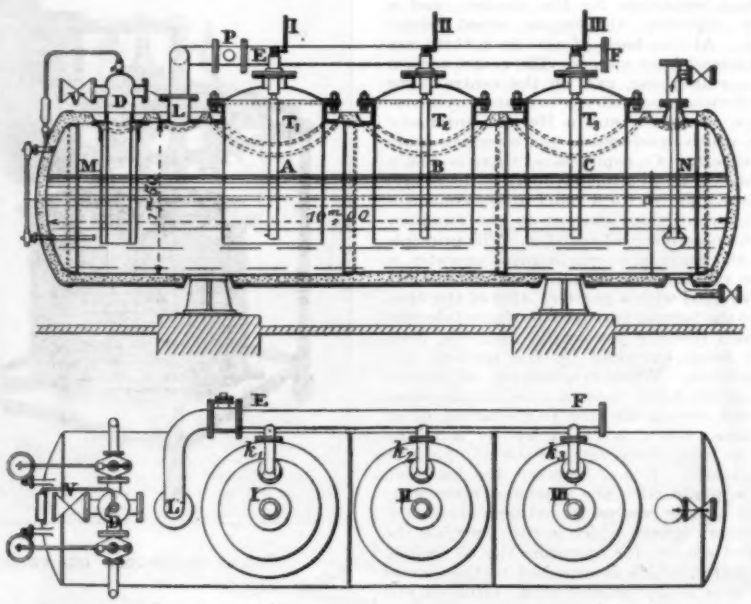
Electric Steam Boiler.

For some time past there have been in operation in Italy, Switzerland, and France boilers in which the steam is generated by the passage through the water in them of electric current. Our contemporary, *Le Génie Civil*, in its issue of last week, describes a large boiler—one of two—working on this principle, which are of the Bergeon-Frédet type and which have been supplied by the Etablissements Joya, of Grenoble, to a paper works at Brignoud, in the Department of Isère. Actually the installation at the works comprises three of these electric steam boilers, but one of them is only half the size of the others and was laid down experimentally. The results obtained with it were, however, so successful that the two larger boilers, each of which is sufficiently large to absorb 3500 kilowatts of electrical energy, were ordered. A longitudinal section and a plan of one of the larger boilers are shown in the accompanying illustration, which is reproduced from the pages of our contemporary. As will be observed, the shells are 10 m.—32.8ft.—long and 1.75 m.—5.74ft.—in diameter. Descending into the shell so that their open ends extend for some considerable distance below the water level are three tubular steel vaporisation chambers A, B, and C, which are bolted to seatings riveted to the plates of the boiler and are closed at the top by steel covers. Each cover is pierced with a central hole for the passage of an electrode, and each is also furnished with an opening to which the steam pipes k_1, k_2, and k_3 respectively are attached. All of the latter communicate with a steam receiver E F. Special insulators made of fused quartz are employed for the electrodes T_1, T_2, and T_3 where they pass through the covers, the arrangement being such that the joints are steam-tight. The receiver E F has a connection L to the steam space of the boiler and is furnished with a valve P, the use of which will be explained later. The whole boiler is lagged with a non-conducting composition.

In operation the boiler is first filled with water up to a level M N, which is determined beforehand by experiment so as to give the electrodes the correct immersion to produce the desired quantity of steam. The three-phase electric circuit is then closed through the terminals I, II and III, and the boiling point in the chambers A, B, and C is quickly reached by reason of the heat generated by the passage of the current between the three electrodes through the body of the water. The steam formed in the chambers A, B, and C is led through the pipes k_1, k_2, and k_3 into the receiver E F and thence passes through the communicating pipe L into the steam space of the boiler, where it unites with the steam coming off from the top of the water outside the vaporisation chambers. Finally the steam passes through a gauze separator to the dome D and thence into the steam mains by way of the valve V.

The regulation of the amount and pressure of the steam produced is effected by means of the valve P, which, as explained above, is inserted between the receiver E F and the pipe L leading to the steam space in the boiler. By closing the valve slightly the pressure of the steam in the chambers A, B, and C tends to become higher than that of the steam in the boiler space, with the result that the level of the water in those chambers is lowered, so that, consequently, the electrodes have less immersion, less current can flow through the water, and less steam is produced. The limit in this direction is reached when the valve is closed. All the water is then driven from the chambers, and, the electrodes no longer dipping into water, no steam is produced. As a matter of fact it is not suggested that, in order to stop steaming, the valve P should be closed if the stoppage is to be of any duration; the valve is rather used as a regulator than a stop valve. If an absolute stoppage for any length of time is desired the current supply is cut off. The working steam pressure is given as being some 85 lb. per square inch.

Commenting on this method of steam raising, our contemporary remarks that in small boilers an electric pressure of 6000 volts can only be used when the water employed is very pure and when great care is taken to see that every part of the installation is operating properly. For small boilers the makers will only guarantee good working with pressures below some 3000 volts. The large boilers at Brignoud, on the other hand, have apparently always worked well and with remarkable regularity with an electric pressure which, though nominally 6500 volts, is frequently as high as 7000 volts for some hours at a time when the supply network from which the current is drawn is lightly loaded. In small boilers an absorption of more than 300 horse-power per electrode should not, apparently, be attempted, but with large boilers up to 800 horse-power per electrode can be readily absorbed. Each of the larger boilers at Brignoud can evaporate 4500 kilos.—nearly 10,000 lb.—of water per hour. Our contemporary does not, unfortunately, make any reference to cost, either of installation or operation.



THREE-PHASE ELECTRIC STEAM BOILER

The Slieve Donard, for the London and North-Western Company's North Wall service, was launched from Messrs. Vickers' yard at Barrow on the 6th instant.

THE INSTITUTION OF CIVIL ENGINEERS.

The one-hundred-and-third session will be opened on Tuesday, November 1st, at 6 p.m., with an address by Mr. W. B. Worthington, President, who will, on its conclusion, receive the members in the Library. The hour of meeting named has been adopted by the Council as the result of the inquiry recently addressed to the Institution, as being likely to meet best the general convenience of the members. The papers to be considered will be announced in the customary way in the Press and otherwise, as they are fixed. Whilst the conditions during recent years have not been very favourable to the production of papers on new civil engineering works of importance, the recent conference has shown that there are many developments of interest in progress. The Council welcomes original communications upon all such subjects, and would urge that the presentation of these papers affords the most effective assistance which members can render to the objects and usefulness of the Institution.

There are other directions in which material aid may be given to the prosperity of the corporation, the prestige of which is identified with the professional interests of all who are associated with it. The Council will much value action taken to secure the attachment to the Institution of every properly qualified civil engineer; and, in an especial degree, the endeavour of the members to encourage and assist young men who are about to enter the profession of engineering, to adopt the course of training advocated and recognised by the Institution, and to enter as students at as early age as may be practicable.

Copies of the forms prescribed by the by-laws for the proposal of candidates for election, for transfer to full membership and for admission as students, may be obtained on application to the Secretary, at Great George-street, Westminster, S.W. 1.

BRADFORD TECHNICAL COLLEGE.

The College of Technology at Bradford is an institution which, from somewhat humble beginnings as a Mechanics' Institute, has made steady progress, until at the present time it can be looked upon as an educational institution worthy of a city which is famous all the world over for its textile and engineering industries. In 1911 the premises were greatly enlarged by the erection of a block of buildings designed specially for a textile department and power-house. This section is equipped with a complete plant for the washing, carding, combing, spinning, weaving, dyeing and finishing of textiles. Later, in 1919, separate departments of dyeing, electrical engineering and biology were constituted, and with a view to the provision of adequate laboratory accommodation for these departments, together with the civil and mechanical engineering sections, a new block of engineering laboratories is now in course of erection, which will prove a great source of benefit to the students. In these new buildings, which we recently had an opportunity of inspecting, there will be special equipment for heat treatment, metallography, oxy-acetylene and electric welding, pattern-making and plumbing work, while research rooms for mechanical engineering will also be provided. In connection with the training of engineering apprentices, a scheme, which was recommended by an advisory committee comprised of several prominent Bradford engineers, has now been in operation for about two years. The scheme, which has worked very satisfactorily, is designed to include boys from the age of fourteen, and is based on the principle of selection. From the very commencement of the training a sifting process takes place, the tendency of which is to bring the best boys to the top, while helping those less gifted to improve their standard. The examinations are such that only a comparatively small percentage of the boys will be able to attain the higher branches of training, thus preventing inconvenience to their employers by the absence of large numbers of youths at the ages when they are most useful. In the scheme, too, account is taken of the progress made by the boys in the works. The principal, Mr. H. Richardson, B.Sc., informs us that this scheme has the goodwill and patronage of all the leading engineering firms of the city.

Railway Matters.

Most of the companies are continuing the issue of eight and fifteen-day cheap tickets up to the end of October.

The sum of £11,031 was raised for the War Seal Foundation by the efforts of the staff and servants of the London and North-Western Railway, whose section of the fund is now closed.

We hear with regret of the death, as a result of a cold caught on the football field, of Mr. J. A. Bowes, the southern divisional running superintendent of the London and North-Western Railway.

By an alteration in the positions of certain signals and by the provision of others, the length of the journey between Finsbury Park and Hammersmith on the Piccadilly section of the London Electric Railways has been reduced by two minutes.

The Canadian Pacific Railway Company has entered into a contract for a 68-mile extension of its line from Kipawa to the Quinze, with a branch line of 8 miles to Ville Marie, on lake Temiskaming, in the province of Quebec. The new line will give access to valuable timber and water-power resources.

According to the particulars published with a view to the sale of the Gretna explosives factory, there are on that property 40¼ miles of standard gauge main line and 36¼ miles of sidings. There are also 49 miles of 2ft. gauge railway. These railways are fully signalled, with signal-boxes containing an aggregate of 500 levers and operating 251 signals.

The Swiss railways have been running a series of tests on a turbine locomotive, equipped with a condensing Zoelly turbine with a gear drive. This locomotive does not differ much from the average reciprocating type. The turbine is mounted in front of the smoke-box and the condenser beneath the boiler. The condensing water is cooled in a cooler carried by the tender, by spraying a fraction of the water into air currents produced by the motion of the locomotive.

On page 100 of our issue of July 22nd we referred to some brake tests on a train of 100 cars on the Virginian Railroad. This trial has prompted a correspondent to write to the *Railway Age*, New York, to say that on November 15th, 1914, a test was made as to the greatest length of train practicable, and that one with 201 cars, drawn by three locomotives, was taken from New Haven to Harlem River, New York City. The train weighed 3962 tons without the locomotives.

The fatal tramway accident at Tynemouth on July 31st, in which five passengers were killed, is considered by Major Hall to have been due to the driver not being fully prepared for the greasy condition of the rails owing to recent rain, not sufficiently applying the track brake, and losing control of the car in the first instance by the too sudden application of the hand brake. The driver having failed to regain control on a comparatively easy gradient, the car attained a speed of something like 25 miles an hour, and the driver appeared to have lost his head, and applied the forward instead of the reversing control.

The *Revue Politique et Parlementaire* recently published some interesting figures as to the ratio of expenditure to receipts of the French railways during 1920. They are as follows:—Nord, 140 per cent.; Est, 121.7 per cent.; P.L.M., 116 per cent.; Orleans, 135.2 per cent.; Midi, 148 per cent.; and Etat, 157 per cent. In 1913 the ratio for the privately worked lines was between 55 per cent. for the Midi and 61.3 per cent. for the Nord; the Etat was 85.4 per cent. The increases are due to the higher cost of labour, material and fuel. The number of men in 1920 was 40.6 per cent. greater and their pay 319.2 per cent. greater. Coal was 900 per cent. higher.

To accommodate the contraction and expansion due to changes in temperature of the rods for working points, so that the movement remains constant, it is the practice to provide compensators midway between the operating lever in the signal-box and the points. There have been numerous types of compensators, but one weakness in most has been that sufficient provision was not made for the big movement—sometimes 9in. or so—caused by an extreme variation in temperature. We have been interested, therefore, in studying the capacity of a new compensator that meets those difficulties, which has been designed by Messrs. Saxby and Farmer—now associated with the Westinghouse Brake and Saxby Signal Company.

A cable advice from New York states that the State Transit Commission, i.e., a Commission appointed by the State of New York to consider transit in the city of New York, has recommended municipal ownership of the tramways, elevated railways and the subway lines. The situation there in this matter is very confused. The original subway and its extensions belong to the city, but are operated by the same company as that which owns and operates the elevated railroads. These are paying concerns at the present rates of fares, but some of the tramways are not. The Public Services Commission opposed any increase in fares to meet the higher cost of operation, but lately conceded the holding of an inquiry, with the result indicated above.

Looking through a volume of reports by Sir Frederick Smith, the first inspecting officer of railways to the Board of Trade, during the year 1841, it is interesting to see what important railways celebrate their eightieth anniversary this year (1921). Among them are:—The section of the Manchester and Leeds Railway—now the Lancashire and Yorkshire—between Hebden Bridge and Littleborough, which included the Summit tunnel, 1¾ miles long; the Great Western between Swindon and Bath, which completed "that magnificent work which will afford railway communication between the Metropolis and Bristol," and between Bristol and Bridgwater; the Brighton railway from its junction with the Croydon railway to Hayward's Heath and—added two months later—from the latter place to Brighton; the Edinburgh and Glasgow Railway—now part of the North British—of which it was said that no line in the kingdom possessed so great a number of beautiful pieces of masonry.

Notes and Memoranda.

In concluding an article on the effects of tidal bores, Mr. W. Gore, in the *Engineering News Record*, says that from observations of several different tidal rivers he has come to the definite conclusion that a tidal bore is evidence of a defective channel from a navigation point of view, and is not the cause of the channel being defective.

The new motor fuel described to the French Academy of Sciences by M. Mailhe is made by passing linseed and other vegetable oils over a special apparatus removing water and hydrogen, and then over nickel. The resulting volatile product is claimed to have the qualities of petrol, and to be useful not only as a motor fuel but as a material for manufacturing explosives, colouring matter, and perfumes. It is stated that various other vegetable and animal oils can be employed for synthetic petrol.

The machinery for a power plant in California had to be transported part of the way to its destination by road, and the final 10 miles included gradients of 10 per cent. One of the 65-ton rotors was mounted on a special truck and required two caterpillar tractors and seven motor wagons to move it. The second rotor was lagged with wood and was rolled along the road by only one of the tractors hauling on a wire cable wound round the rotor. The time occupied in the trip was the same in each case.

A British Standard Specification has been issued by the British Engineering Standards Association for Creosote for the Preservation of Timber. The specification covers the requirements of creosote suitable for the treatment of railway sleepers, and for telegraph, telephone, and hangar poles, and similar purposes. The clauses of the specification include a description of the substance and limits for specific gravity, fluidity, water content, distillation, tar acids, and matter insoluble in benzol (benzene). These are followed by an addendum governing the supply of Scottish creosote and appendices giving the necessary tests.

In 1913 the output of iron ore in the territory now forming Soviet Russia amounted to 9,000,000 tons. The bulk of this was absorbed by the home market. For the same year the exports amounted to about 470,000 tons. For the first half of this year the total output of iron ore was only 100,000 tons. In 1913 Russia produced 1,280,000 tons, or 56 per cent. of the world's output, of manganese ore, but this year only about 3600 tons were mined during the first six months. With copper the situation is even worse, the production having fallen from over 1,000,000 tons a year to some 4400 tons for the first half of 1921.

The fire-resisting qualities of wooden stave piping were recently demonstrated by a test carried out at Seattle. The pipe was a 6in. water main, carrying water at a pressure of 125 lb. per square inch, and had been creosoted. The test section was completely covered with fine kindling saturated with paraffin oil. The fire was then kindled and immediately became intensely hot, causing the galvanised steel wire winding to elongate. This elongation permitted the staves to separate. The consequent leakage immediately reduced the intensity of the fire, and eventually extinguished it. The pipe section continued to leak considerably through the seams. The leakage, however, diminished as the wire winding cooled. Two hours after the fire had been started most of the leakage had stopped; and two hours later leakage had entirely ceased.

While there are many and varied mineral resources in the hill districts of Angola, the chief interest at the present time centres, according to the *South African Mining and Engineering Journal*, in the accessible oil area near the coast, where river, as well as railway, communications are available for transport to Lobito Bay, the port of shipment. The existence of oil in Angola is no new discovery, for Portuguese official reports as far back as 1844 referred to extensive deposits of petroleum, almost all of which were stated to be situated at points near the coast or near navigable rivers. But prospecting was slow, and little was done till the American Petroleum Company struck a very promising area just north of the Benguella Railway and started active exploitation. An important concession has also been acquired by British interests. It comprises an area of 107,000 square miles from the coast inland, with a coastal extension of 250 miles from the Benguella Railway southward to Port Alexandria.

According to an article in the *Electrical World* by Mr. Y. Ishikawa, of the Tokyo Electric Company, more than half the people of Japan live in electrically lighted houses, a percentage claimed to be higher than in any other country. The growth of the electric supply industry in the Island Empire has been remarkable in the last fifteen years, the number of electric supply companies having increased from 500 in 1903 to 3400 in 1918, and the installed rating of the plant from 90,000 kilowatts to 1,820,000 kilowatts. At present the generators installed have a rating of over 2,100,000 kilowatts. There are about 6,000,000 wired houses, but the average installation is between two and three lamps, and in Tokyo it is only four lamps per house. In Yokohama 92 per cent., in Nagoya 85, and in Kobe 80 per cent. of the houses are wired, but in the latter case the average number of lamps per house is only 1.2. Successful efforts are being made to increase the number of lamps and to improve the illumination.

In a paper read before the British Commercial Gas Association, at Glasgow, Mr. John W. Lusky (engineer and manager of the City of Glasgow Gas Department), dealt in considerable detail with the hygienic qualities, or otherwise, of various forms of artificial heating. The open coal fire gave out radiant heat, and so did the modern gas fire; but the modern gas fire had the advantage over the coal fire in having a much greater regularity of heating. In addition, it provided a glowing fire almost immediately after lighting, whereas the coal fire took some time to "burn up" after being lit. A gas fire, too, could be easily regulated, and the heat of the room controlled in a way which was not possible with coal fires. The coal fire, moreover, was a smoke producer and a defiler of the atmosphere; while the gas fire was smokeless. Comparing the gas fire of to-day with that of fifteen or twenty years ago an enormous improvement in construction and design had taken place during that period. The gas fire of to-day was, he said, "hygienically perfect."

Miscellanea.

A course of lectures and discussions on problems of public health in relation to industrial hygiene will be delivered in the lecture theatre of the Royal Institute of Public Health, 37, Russell-square, London, W.C. 1, on Wednesdays, October 19th, to December 7th, 1921, at 4 p.m.

Arrangements have now been made, according to the *Canadian Engineer*, for proceeding with the construction of a new power plant on Winnipeg River, some 79 miles from Winnipeg. The plant is to have a capacity of 168,000 horse-power and will cost nearly 20,000,000 dols. The turbines will operate under a head of 56ft.

We hear that a resumption of work in the Danish electro-chemical industry, which has been idle for a long time, is to be attempted. Mediation regarding new wages tariffs will commence, and in case of a solution being reached all the carbide factories, aluminium works, and large factories in Odda are expected to resume work.

In a letter to the *Times*, Mr. Robert Donald suggests that there could be no better way of finding useful and necessary labour for unemployed men than by the erection of wireless stations, in connection with the Imperial Wireless Chain, which would employ engineers, brass founders, electricians, and other skilled workers, as well as builders' labourers.

The construction of a deep-water quay at Brest Harbour has been authorised by the French Ministry of Public Works. According to the British consul at Brest, the estimated cost of the necessary works is 15,500,000f., or, say, £304,000 at the present rate of exchange, or 17,000,000f., say, £333,333, including the cost of the construction of railways leading to the quay, which are estimated to cost 1,500,000f., say, £29,412. The quay will be 245 m. in length and will be provided with four electrical cranes of 8 tons lifting power.

A Spanish Royal decree announces the obligatory formation of Chambers of Mines in all the mining districts of the country. The object of the new chambers will be to encourage the mining and metallurgical industries, to furnish statistics and information, to found or subsidise mining schools, to raise loans with the authorisation of the Ministro do Fomento, to intervene in labour disputes, to attend to all questions relating to hygiene and sanitation in the mines, and to assist in the distribution of labour by the establishment of labour exchanges. The number of members in each chamber is fixed at not less than ten or more than forty. The new chambers will act as consulting bodies to the Government, and their views will be requested on all new projects, customs changes, &c.

According to the *Textile Recorder*, many Irish textile firms are now taking advantage of the slackness in manufacturing to bring their mills and factories thoroughly up to date. The directors of Wolfhill Spinning Company, Limited, Belfast, are having their present system of steam-driven machinery superseded by a complete electrification of the mill. The new plant will include a Rateau impulse type turbine direct-coupled to a three-phase 50-period 3000-revolution alternator, with a direct-coupled exciter having a radial type commutator. The set is designed to give a normal full load of 1000 kilowatts, and to pass 6000 lb. to 10,000 lb. of steam at a pressure of 20 lb. per square inch to the heating system. This represents double the power of the present beam steam engine, while only one-twentieth of its space is occupied.

Western Canada, states the *Board of Trade Journal*, has experimented with farm tractors of various sizes and styles for some years, and it has been found that a tractor weighing from 4000 lb. to 6000 lb. having 12–14 horse-power at the draw-bar and 25–27 horse-power at the belt pulley, gives the best results for the average grain lands of the West. Such tractors are made in the United Kingdom. Their present cost is rather higher than machines of similar power from the United States. The British product is generally a very much better engineering job than the average American machine. Until now price and power have been the main determining factors in the sale of tractors in Western Canada. From now on, however, a better quality tractor will be demanded, and herein lies the British manufacturer's opportunity. Slight modifications in the usual British tractor will be necessary.

The Department of Scientific and Industrial Research announces that the MS. copy of the Bibliography of Lubricants, compiled by the Lubricants and Lubrication Inquiry Committee, referred to in the report of the Committee of the Privy Council for 1919–20—Command 905—has been placed in the library of the Department at 16–18, Old Queen-street, Westminster, S.W. 1, and is available for reference. Owing to the expense which would be involved, it is not possible to print this bibliography as originally intended. The bibliography contains, in a classified form, references to every paper on lubricants and lubrication which was considered by the Committee as being of definite importance. It is divided into two main parts, the papers being classified according to authors and to subjects. The references themselves are divided into two sections, one dealing with the chemical, the other with the engineering and physical aspects of the subject.

American motor cars and motor trucks prevail in Canada. The Canadian requires first-class service in connection with the supply of spare parts, and this is well provided by the many dealers and agents in all parts of Canada handling American and Canadian-made cars. The Canadian purchaser prefers a standardised car rather than a car built and equipped to individual taste. An excellent five-passenger four or six-cylinder car, fully equipped with electric starter and lights, can be purchased retail in Canada for £400 to £500. The finish or quality of such a car will not equal that of the British-built vehicle, but the price and power apparently meet requirements. According to the *Board of Trade Journal*, however, the demand for the large first-class British-built car in Canada will be quite limited for some time. In motor trucks a much better opportunity exists. One well-known British firm has a few trucks in daily use in Western Canada, where they are giving complete satisfaction.

MACHINERY FOR PUMPING OIL THROUGH PIPE-LINES IN AMERICA

(*For description see page* 393)

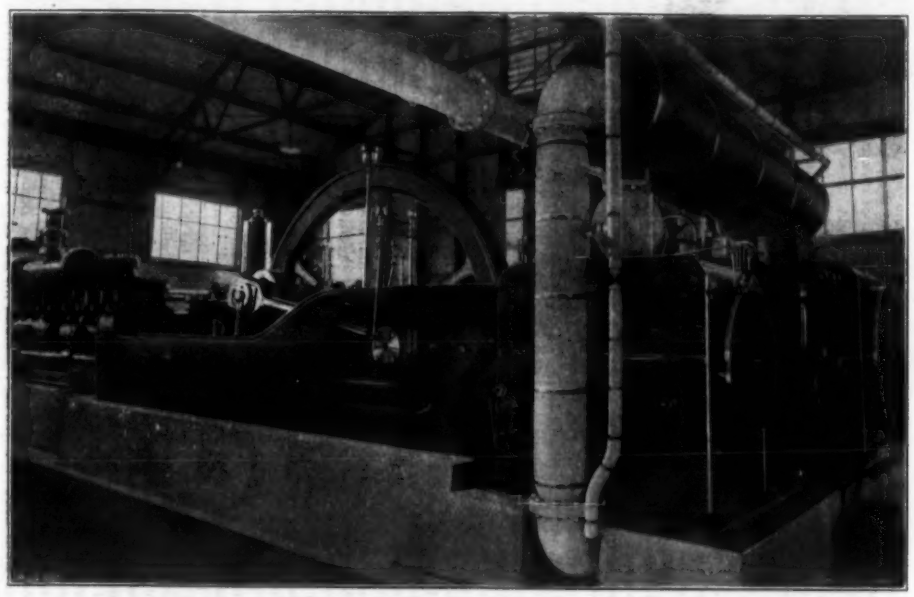


FIG. 11—STEAM OIL PUMP—CAPACITY 2500 BARRELS PER DAY AT 900 LB. PRESSURE

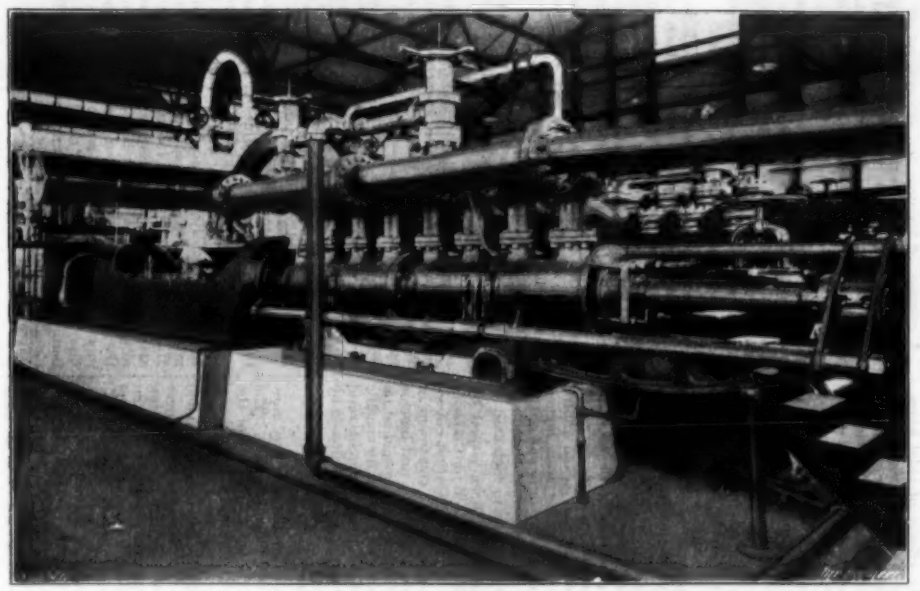


FIG. 12—PUMPING END OF THE SAME ENGINE

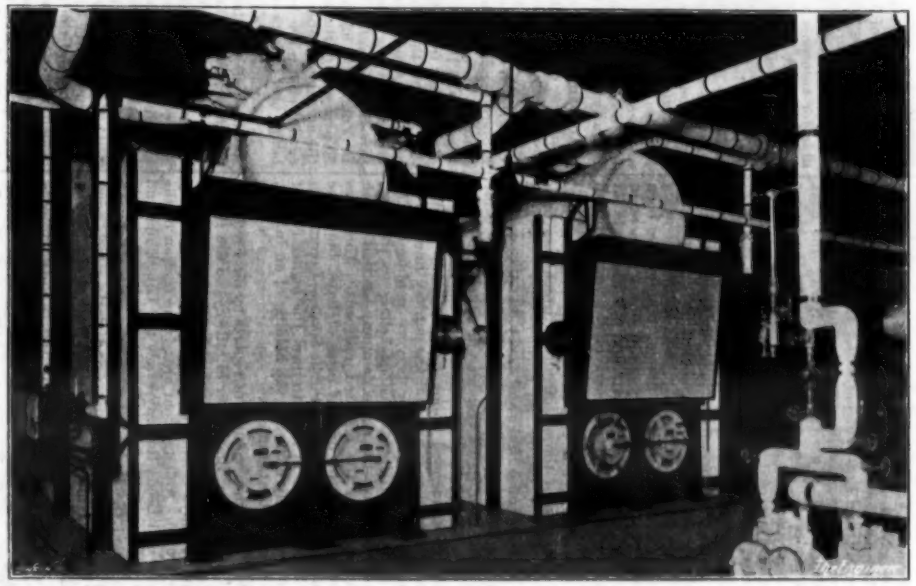


FIG. 13—OIL-FIRED WATER-TUBE BOILERS FOR PUMPING STATION

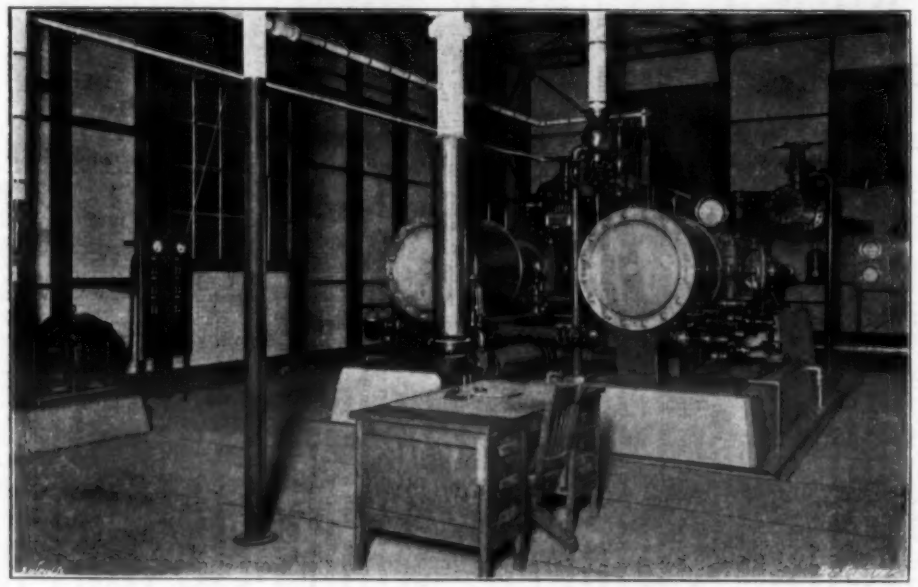


FIG. 14—DUPLEX PUMP FOR AUXILIARY SERVICE

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By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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THE ENGINEER.

OCTOBER 14, 1921.

Fool-proof Railway Signalling.

All too often the inexperienced inventor of railway signalling appliances forgets to make allowance for the failure of his mechanism; he bases his scheme on everything being in good order and working exactly as in his model. For example, the majority of cab signals, for which patents have been taken out, operate on the obstruction-in-the-track principle. When the signal is "on," a ramp or other obstruction in or by the side of the four-foot strikes a lever on the locomotive and causes an alarm to be given. Rarely indeed does one find allowance made for the track mechanism or the engine lever being carried away, bent or broken, so that no alarm is given, and the driver assumes that the line is clear. Nor is provision always made for the wire contracting or being held up between the signal and the track mechanism, so that the latter may be at "clear" even though the signal is "on." Another direction in which innumerable ideas have been put forward is in compensating for the contraction and expansion of signal wires due to changes in temperature in order to keep the wire tight and the amount of stroke constant. Many of these inventions employ the principle of a midway floating weight, but that the breakage of the wire between the signal-box and the compensator might lead to the floating weight pulling the signal "off" is overlooked. In other types of compensators there is no provision for adjusting the wire when the signal is "off," which is awkward if adjustment has to be made at night or on Sunday, when the signal-box may be closed. Then there are efforts to guard against collision by holding the block instruments until the train has gone over a contact within the area protected by the next signal-box. In this case inventors frequently overlook the fact that the train may become separated on its journey, with the result that the first portion clears the section whilst the second part is still in possession.

We are led to make these observations because a good deal lately has been said about "fool-proof" signalling. We fear it must be admitted that there is no such thing. It is possible to fit up a line with track circuit in such a way that short-circuiting by a train or vehicle, or by a rail being broken, shall effectively cause the engine to come to a stand. It may further be provided that if the current fail the consequences shall be on the side of safety, *i.e.*, that the train shall be stopped. But serious inconvenience may result; hence some temporary expedient must be adopted so that when the current fails the traffic can be worked, for otherwise the inconvenience may grow into a danger. Some inventors are so confident in their "fool-proof" schemes that they would have all the fixed signals dispensed with as quite unnecessary. This plan, leading to economy, may seem commendable, but it must not be forgotten that the fixed signals serve many useful purposes not generally recognised. Their condition can be seen at some distance, and so the driver is prepared before he reaches them. He cannot, however, know in what state he will find the next control section in these automatic systems. Fixed signals, too, are seen by firemen and guards, who can, if necessary, dispute or corroborate a driver's statement. They act, too, as a warning to platelayers and others, working or walking on the line, that a train is approaching. Any want of foreknowledge by a driver of the state in which he will find a control section adds to the anxieties of his occupation. Now he can be prepared for the warning given by a distant signal, but in these so-called "fool-proof" methods the alarm may come suddenly and call for immediate action. Another important point arises if the train is automatically stopped when approaching danger. What is to happen, supposing the train is stopped owing to the track battery giving out or to a bond wire breaking? The engine mechanism will then be de-energised and the train will not only come to a stand, but will not start again until the fault is repaired, which may take several hours. Something of the same sort may possibly arise should the engine mechanism so fail that it goes on and cannot be taken off again. There must, therefore, be some release to meet these conditions and to allow the engine to move, but as soon as it is provided the apparatus ceases to be "fool-proof." Again, all our lines are already provided with fixed signals, and automatic systems must work in connection with them. In that lies a difficulty for the inventor; his schemes rely on virgin ground, untrammelled by any existing apparatus. When approaching a signal-box the driver has to be told whether or not he will find the home signal "off," and if it be "off," whether or not the starting signal is "off." The fixed distant signal gives the driver this information and the automatic system should do the same. With fixed signals, in fact, a combination of indications as to speeds and routes is practicable. Fixed signals tell a driver how the road is "set" and warn him at a facing junction that the points lie for the direction, say, to the left, which calls for a reduced speed; were they "made" for the right the speed might be normal. The inventors of "fool-proof" signalling meet this need by providing "speed control" by which a limited speed is automatically ensured and therefore, they say, it is immaterial if the driver is not prepared for being turned to the left. The control mechanism generally consists of a governor set for a certain number of revolutions per minute. The area where a speed limit is in force has a special electrical circuit whereby the governor is brought into play, and if the determined number of revolutions be exceeded an automatic control is applied so that the speed is brought down to and retained within the limit. The governor has, of course, to be set for the prescribed limit whilst the engine is at rest, but how the adjustment for a speed of 20 miles per hour at one point and 30 or 40 miles per hour at other points on the same run is to be met has yet to be solved. Another feature about speed control is that many engines are used in both passenger and goods traffic. They may work a passenger train on the outwards journey and return with a goods train. The latter, for a speed limit of 20 miles per hour over a curve, calls for an earlier brake application than with a passenger train. How is this to be done?

It will be seen from what we have said that the invention of a perfectly "fool-proof" system is well-nigh impossible on all save very simple railways. At some point or other in all systems the human element must come in, and it may fall into error. The electrical tablet system for single lines seems as nearly "fool-proof" as one could desire, yet we know how, through carelessness in the use of the tablet itself, it went wrong at Abermule, and in an earlier case a defect in the electrical circuits caused two instruments to be released at once, with the consequence that two trains met head on. The terrible disaster of the 5th instant in the Batignolles tunnel of the Gare St. Lazare, Paris, may have been another failure of a so-called "fool-proof" system. When the first train entered the tunnel it locked the entrance signal behind it, and it could not again be lowered until the train had passed out of the tunnel and gone over an electrical contact. Something or someone failed on this occasion; it may have been the signal or may have been the contact. Or, possibly, both may have been in order, and the signalman, overlooking the first train owing to the long time it was in the tunnel, may have assumed that it had passed out and that the machine had failed to do its work. It is probable that in the long run human failures are less frequent than the failures of complicated machinery exposed to trying conditions, and the inventor may be well advised to give up the search

for the absolutely "fool-proof" and content himself with a more moderate ideal which leaves something to human vigilance and human discretion Rather, we should say, do we need aids and prompters to the human machine than its total obliteration.

Electrical Fires.

When there is doubt as to the cause of fire, electricity is almost invariably held responsible. "The outbreak was probably due to the fusion of an electric cable or wire," is a phrase with which we are all familiar, but it would be interesting to know in how many instances the assumption is really justifiable. Fires occurred long before electricity came into use, and they still originate from many causes which have no connection whatever with the use of electric light or power. It is, nevertheless, by no means surprising to read in the daily papers that electricity was in all probability at the root of the fire which reduced the Magasins au Printemps to ashes. Of the articles bearing upon this disaster, that which appeared in *The Times* last week under the heading of "Electrical Dangers in the Home," is perhaps the most original. The author, who is not wholly antagonistic to electricity, attributes electrical fires to the use of pressures in the neighbourhood of 250 volts, and asserts that in the days of low voltage such fires were practically unknown. "We have travelled," he says, "far from the days when, escaping for the time from watchful eyes and careless of swiftly following penitence, Tom and Mary, aged seven and five, could poke the points of a pair of scissors into one wall socket after another in the house, to see the sparks, and beyond giving an hour's work to the electrician, do no harm to anything, except the instrument of their joy. That was in the blessed days of low pressure, when electrical fires were hardly on the fire brigade lists, and each wall socket had a little fuse of its own to blow, with a faint splutter and no more."

It is, possibly, because this juvenile practice of poking the points of scissors into wall sockets does not come within our own experience, that we do not quite follow the writer's argument. It is true, of course, that the higher the pressure the greater is the risk of a short circuit and fire if the insulation happens to be imperfect, but it is also true that in the early days the relative high currents which were needed to obtain a given amount of light or power sometimes caused local heating at imperfect contacts and at bad joints. Electrical fires were certainly not unknown in the days of low voltages, and the probability is that, if due allowance is made for the vast difference in the number of consumers in the two cases, electric fires were more numerous in the early days than they are at present. The use of a pressure such as 50 volts, is, of course, now out of the question. Pressures in the neighbourhood of 250 volts are needed to keep down the size of the mains and internal wiring. A consumer who desires to use current for purposes other than that of lighting, such as heating and cooking, would, with the old pressures, require very heavy cables and fittings, and the initial expense would be great. Given good workmanship and materials, there is little fault to be found with the pressures now commonly adopted, except perhaps that they sometimes make the consumers use more powerful "gas-filled" lamps than are really needed. The writer of *The Times* article comes nearer to the cause of electrical fires when he refers to the replacement of fuses and the use of flexible cords, although he seems to have overlooked the fact that the fuses and cords commonly employed are not the only kind on the market. His assertion that consumers frequently increase the risk of fire by fusing their circuits with wires of a heavier gauge than those which were originally provided is, of course, correct. The ordinary open type of fuse enables the consumer to use any size of wire he pleases, but this dangerous practice is obviated by cartridge fuses, which are composed of a fibre tube with the wires sealed inside. In the case of ordinary fuses, it would, we think, be a good plan to place instructions on the case, or, alternatively, to give the character of the wire needed for fusing the circuits on each porcelain fuse holder.

As regards flexible cords, there is no doubt that when they are old and damaged they are to some extent a source of danger, although we have never seen one burst into flames in the manner which the author of the article describes. Here, again, however, the ordinary "flex" is not the only material for supplying current to portable lamps and electrical domestic appliances. For use in places where the insulation is liable to be damaged, wire covered with cab tire sheathing is infinitely better, for long experience has shown that the covering is practically indestructible. What prospective consumers should endeavour to do is to place the wiring work in the hands of a thoroughly good contractor. Many of the troubles that arise in connection with electrical installations are due to bad workmanship or to the use of materials which are unsuitable for the conditions. Fires may arise as the result of bad contacts or faulty insulation, but it is our opinion that many of them have originated from the use of electric lamps in close proximity to goods that are easily ignited. The electric lamp, with its heated filament enclosed in a globe, appears so safe that undue risks are often taken. The great fire which occurred some years ago at the large drapery establishment at Clapham was, it is said, due to placing electric lamps near flimsy goods, and there is no doubt that many other so-called electrical fires have had a similar origin.

Railways and Unemployment.

It has been suggested that the railway companies could find plenty of occupation for some of the unemployed were they able to raise the necessary capital for new works at a reasonable rate of interest, and that this condition could be attained by the Government making up the difference between the rate of interest the companies are willing to pay—say, 5 per cent. per annum—and the market rate. We doubt, however, whether much could, in fact, be done in this direction, and whether, in view of the forthcoming consolidation of the railway systems into four groups, the companies are in a position to say definitely what new works are necessary. Even were it apparent that certain widenings, additional accommodation, &c., are essential, in any event such works must be preceded by the preparation of drawings and quantities, the solicitation and submission of tenders, the letting of contracts, and the delivery of plant and material on the ground. All this is the work of months. It is possible that material might be ordered by the companies as a whole and placed in a common stock to be used, and paid for, by the companies as required. But the uncertainty of the future, arising out of the grouping, again enters into this aspect of the question, as it would be foolish to order, for instance, locomotives and carriages since, under consolidation, there are probably more than enough already. Equipment for stations is another detail that can scarcely be touched, for many stations may be closed, whilst many may have to be enlarged. Wagons, however, with their shorter life, and rails and certain sizes of girders, must continue to be required. There is not much hope, therefore, in these directions, but money might certainly be usefully advanced for the completion of unfinished electrification schemes. The plans no doubt exist, and possibly the respective companies have the tenders. It is work, too, that will be necessary whatever may be the future of any particular company. We have more particularly in mind the completion of the London and South-Western suburban service to Guildford and the London, Brighton and South Coast through Croydon. Then there are the new fields for electrification, *e.g.*, the Lancashire and Yorkshire between Manchester and Oldham, and the North-Eastern between York and Newcastle. Whatever of these works were put in hand would provide employment in many branches of engineering. There would be electrical machinery, third-rail or overhead equipment, additional signalling, and so on, together with new rolling stock. It has also been suggested that material be similarly supplied to Indian railways to meet the deficiencies of which so much has been heard. But here, we fear, the Government might, with truth, plead that there are difficulties. One, for instance, is the recent decision that Indian firms are to have equal opportunities to tender with British firms for locomotive engines and boilers.

Literature.

Aluminium and Its Alloys. By C. Grard. Translated from the French. 184 pp. Large 8vo. Constable. 1921. Price 17s. 6d. net.

This work forms a new departure in the making of text-books. It does not treat of the metallurgy of aluminium, or of its chemistry—or even of its physical and mechanical properties as accurately defined quantities. Its aim is higher; it discusses the variation of the properties of aluminium and its alloys, when subjected to varying degrees of cold working, varying heat treatment and modes of quenching, &c. &c. The mass of experimental work illustrated by means of graphs is in itself of such proportions as to command respect, and the possible generalisations are left to the reader.

To the specialist this book ought to be welcome as a memorandum of experiments which he has probably made himself to a lesser extent, and to him the terseness of the text, and the absence of all literary effort, will no doubt prove an additional charm. For the amateur there is a collection of micro-photographs and the well-known diagrams of the thermal equilibria of CuAl and CuZn alloys. In making a detailed survey of the book one is from the first left in no state of doubt about the absence of every claim to extreme accuracy of numerical constants. The first lines of Part II., Chapter I. read:—Density: 2.6 (annealed), 2.7 [as worked, or when impurities (iron and copper) are present].

Part of this statement is, according to Brislee and others, untrue, *i.e.*, annealed aluminium is denser than worked stuff. On the other hand, the density of pure aluminium lies between 2.6 and 2.7, and as we have never seen a perfectly pure specimen, this ought to be quite enough. All other constants are given in the same way as orders of magnitude, and thus the book is not intended to replace tables like those of Landolt and others. In the continuation the author treats the variations of tensile strength, elastic limit and elongation of various forms of pure aluminium with degree of cold work and rise of temperature in a very lucid way. He also introduces results of the Persoz cupping tests and of the shock test by the pendulum method. Hardness by the Brinell method and the scleroscope also claim the attention of the author, as well as the influence of time on the properties of specimens. Furthermore, the effects of annealing and over-annealing are reviewed. This scheme, which is further on repeated with relation to alloys, is a new departure, full of practical interest to engineers as well as to metallurgists. The micro-photographs which follow are old friends and might, in company with the chapters on preservation and soldering of aluminium, have been omitted without detriment to the work.

Proceeding to the chapters on alloys, we must confess that the proposed new nomenclature is hardly one to commend itself to chemists. For instance, it is proposed that the formula $Al\ Cu_{11}\ Sn_3\ Ni_1$ should mean: Al, 85 per cent.; Cu, 11 per cent.; Sn, 3 per cent.; Ni, 1 per cent. The wide spacing is not used further on, and the formulæ appear like ordinary molecular ones which are often used in metallurgy, and are thus likely to cause confusion. Leaving this trifling matter, we must say that the treatment of the effect of quenching, time of rest, &c., on the properties of aluminium alloys is excellent and to the reviewer's knowledge true to facts. With regard to duralumin, one would have liked to see a statement as to the effect of storage for a year or two on its mechanical properties, as an accurate knowledge on that point is of utmost importance to aeronautics. The use of the word "cupro-aluminium" instead of aluminium-bronze is hardly to be commended at this date. In connection with these alloys, we must say that the micro-photographs illustrating the effect of annealing on the various types are of quite unusual interest and exceedingly well reproduced. In the details of chemical analysis, given in Appendix I., we are glad to notice that the direct estimations of aluminium and its oxide in virgin metal are given prominence.

The translation is very well done, and the printing is in a pleasing, bold type. We congratulate the author in having made a new departure in metallurgical writing by co-ordinating the facts which are of most importance to engineers, and giving the orthodox treatment less prominence than most other writers, thereby showing the way to future investigators.

SHORT NOTICES.

Who's Who in Engineering. Second Annual Issue. Edited by J. E. Sears, Assoc. M. Inst. C.E. 93 and 94, Chancery-lane. Price 31s. 6d.—We are glad to see the bulk of this volume increasing. Last year it was too thin; too many engineers stood out of it for some reason or another, and it was so far from being complete that it fell far short of the measure of usefulness it might have attained. We failed to understand the objection some engineers had to the inclusion of their names, and we are glad to see that it is weakening. A directory of the kind is much needed in the profession, and the more complete it is the more valuable it will be to all. Part I., which occupies rather more than half the volume—or over 430 pages—is devoted to Personal and Professional entries, and a useful classified register of engineers by professions. Part II. is a directory of engineering firms, many entries including such useful particulars as the names of the directors, capital, number of men employed, products, and so on. An addendum to it is a classified trade directory. In Part III. are given particulars of engineering institutions and societies, technical training centres, research organisations, associations of manufacturers and employers, and the Press. Altogether a very useful book.

The "Proceedings" for 1920 of the Institution of Railway Signal Engineers (Incorporated). Captain M. G. Tweedie, A.M.I.E.E., 80, Caversham-road, Reading (Hon. Secretary). 127 pp. Price 5s.—This volume is of special interest because of the paper by Captain Tweedie on "British Railway Telegraphs, France, 1914–1919," which tells how the lines of communication for the railways at the British front in France were constructed and maintained. So much is to-day heard, too, of track-circuiting in connection with the avoidance of accidents that the paper by Mr. W. C. Acfield will also be found interesting.

The History of Continuous Conveying Devices.[1]

By GEORGE FREDERICK ZIMMER, A.M. Inst. C.E.

THE first machines ever built by man were more than probably labour-saving devices for the conveyance of water, and of them the "Chain-of-Pots" is the progenitor of the bucket elevator, and the Chinese chain pump of the conveyor. Another device is the Archimedean screw, also used in antiquity for conveying water; but it is of small importance as a modern conveyor.

HANDLING WATER IN A VERTICAL DIRECTION BY THE "CHAIN-OF-POTS."

In its earliest days the "Chain-of-Pots," which is supposed to have originated in Persia, consisted of an endless fibre rope, or pair of ropes, to which earthenware pots were attached at frequent intervals. The pots, on passing over the upper terminal wheel, which was about 6ft. in diameter, discharged into a trough; as a rule there was no lower terminal. Thomas Ewbank[2] states that the device may safely be regarded as coeval with the foundation of the city of Babylon, if not, as was probably the case, of much more ancient date. The poetical allusion —symbolising man's life—in the twelfth chapter of the Book of Ecclesiastes, "Or ever the silver cord be loosed, or the golden bowl be broken, or the pitcher be broken at the fountain, or the wheel broken at the cistern," is undoubtedly a reference to the "Chain-of-Pots." The term "silver" refers to the bleached condition of the palm fibre ropes which were alternately wetted and exposed to the sun; "the golden bowl" is an allusion to the colour of the earthenware pots, both pots and cord dripping with water and glistening in the sun, representing to the vivid imagination of the Oriental a striking resemblance to burnished gold and silver. And if the cord broke, which was not infrequently the case, the whole "Chain-of-Pots" would tumble into the well, breaking the pitchers and often the terminal driving wheel also, owing to its revolving either contrary to its wont or at a speed for which it was not intended.

Perhaps the best-known example of an early bucket elevator or "Chain-of-Pots" is that at Joseph's Well in Cairo. It was 165ft. in depth and its capacity was between three and four gallons per minute. The "Chain-of-Pots" mentioned as being used in it consisted of two units in series. The "Chain-of-Pots" or "Sakia," which is still in use in Egypt to this day in large numbers, is mentioned by Sandys in 1611 and by Poncet in 1698.

Amongst the earliest references in literature to the "Chain-of-Pots," Paternoster, or Jacob's Ladder work, is made by Philo of Byzantium,[3] 230 B.C. He describes and illustrates such a machine, which was employed for raising water and was driven by a totally enclosed tread-mill for one man.

A bucket elevator of early type is that mentioned by Capitano Agostino Ramelli,[4] 1588, and illustrated in Fig. 1; it is of special interest owing to the advance made in constructional details. The whole machine, with the exception of the framing, is of iron; the large driving wheel G is of cast iron, and the pinion of cast and wrought. It is driven by a "walking-man" gear and countershaft. The upper terminal of the elevator consists of two cast iron discs E and F, which are connected together by six wrought iron bars forming a hexagonal terminal. The most remarkable feature about the installation, however, is that all the spindles are supported by roller bearings—see H and I.

In "Theatrum Machinarum Novum" (Georg Andream Bocklern, 1673) a great number of primitive chain elevators for raising water are illustrated and described. They were evidently much used during that period.

The "Chain-of-Pots" was used in this country, according to R. D'acres, prior to 1660, and was known as "Bucket-Work," "Bucket-Gin," and "Scotch-Gin."[5] It was more particularly used in Scotland and in the North of England. It consisted of a chain of buckets with two endless long-linked iron chains; the buckets themselves were either wooden barrels, boxes nailed together, as in Fig. 1, or were made of stiff leather. No illustrations of these first machines are available, but a bucket elevator[6] which was used in Bruges in 1663 and which is illustrated

FIG. 2—CHAIN OF POTS, BRUGES, 1663

in Fig. 2 evidently bears a close resemblance to the early British devices with wooden barrels.

HANDLING WATER ESSENTIALLY IN A HORIZONTAL DIRECTION BY THE CHAIN PUMP.

The Chinese chain pump—known in the land of its origin as "Fan Tach'o" and "Chin Chia"—which might be fitly taken as the progenitor of most of the continuous working conveyors and of the push-plate conveyor in particular, is of great antiquity and is closely connected with the agriculture of China. It has undergone no change whatsoever in China up to this very day. It is mentioned in Chinese literature as early as A.D. 1245.[7] It is described by Gamelli[8] in 1695 as a device which only Chinese ingenuity could have invented, while a fuller description and illustratons are given by Leupold,[9] 1724. Reference is also made to this machine by Sir George Staunton in an account of an embassy from the King of Great Britain to the Emperor of China in 1796.

This device consists of a wooden trough divided in the inside along the middle by a board, into two compartments. Flat and square pieces of wood, corresponding exactly to the dimensions of the trough, are fixed to an endless chain, which travels over a roller or small wheel placed at each extremity of the trough; the square pieces of wood fixed to the chain move with it round the rollers and lift up a volume of water equal to the dimensions of the trough. The most common practice of driving this device is by a simple crank turned like a grindstone on one of the terminals, the machine being of wood, including the chain, only the square spindle with its crank being of iron. The terminal to which the crank is fitted is a cylindrical piece of wood with a square hole in its centre for the spindle; in its circumference there are six longitudinal grooves, into which fit six small boards, forming a hexagonal spider. There is a small niche in the centre of each of these boards with which the chain engages, and the pitch of the chain is such as to fit from niche to niche, so that three or four links of the chain are on the terminal.

George Sinclair,[10] 1672, describes the method of removing water from coal mines, and it appears from his description that the Chinese chain pump, as well as the "Chain-of-Pots," was largely used in Scotland in his day. In the eighteenth century the Chinese chain pump was introduced into Britain.[11] During the building of Blackfriars Bridge the water was raised from the caissons by this device, about 1750.

The first recorded European use of this Chinese invention refers to Holland, where it was apparently largely used for removing silt from harbours and docks; it is referred to by Cornelius Meyer,[12] a Dutch engineer, in 1685. According to Leupold, a similar machine was installed in Amsterdam in 1708, under the name of "Modder Moole," or, in English, mud machine. Leonhardt Christoph Sturm,[13] 1721, recommends the use of a Dutch "Modder Moole" to remove silt from waterways. It was stated by Ernst Christian August Behrens, 1789, that Sturm had introduced some improvements in the design of these "Modder Mooles." In 1785, Grundy,[14] engineer of the Hull Docks, had a machine built after the Dutch original for clearing the mud from the dock; all these machines were driven by horse gins.

The same device, says Leupold, was employed in Berlin and the neighbourhood to replace the Archimedean screw formerly employed for raising water.

THE DEVELOPMENT OF THE BUCKET ELEVATOR FROM THE "CHAIN-OF-POTS."

The next development concerned the raising of solids, such as sand, gravel, and probably mortar, to the top of city walls for building or repair work. The view shown in Fig. 3[15] gives some details of construction. In the upper portion of the picture, on the left, the top terminal is shown, driven by worm and worm gearing, while on the right the lower terminal is illustrated; it is provided with tommy bars for a man to assist in turning the machine. A feature of importance in the development of elevators

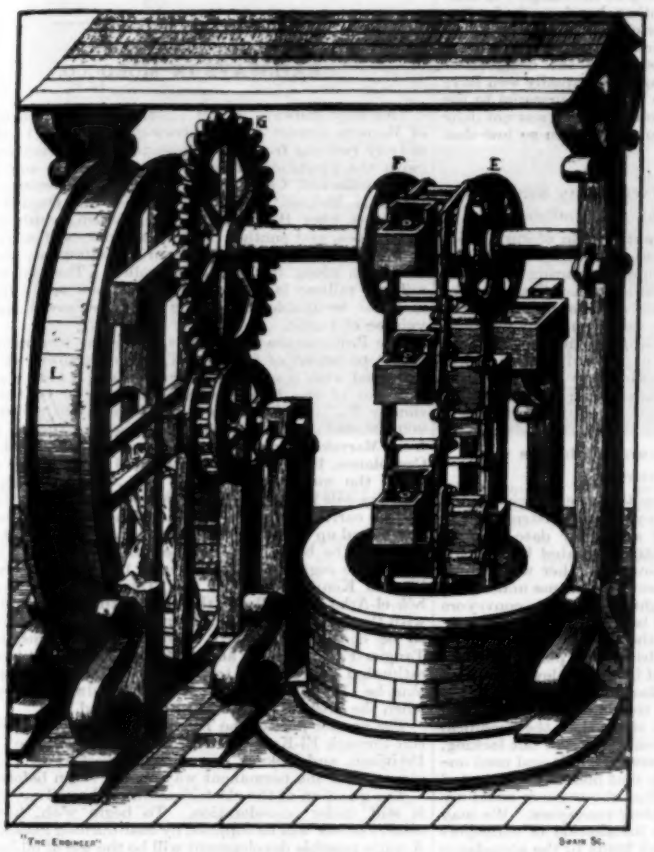


FIG. 1—BUCKET ELEVATOR OF 1588 (RAMELLI)

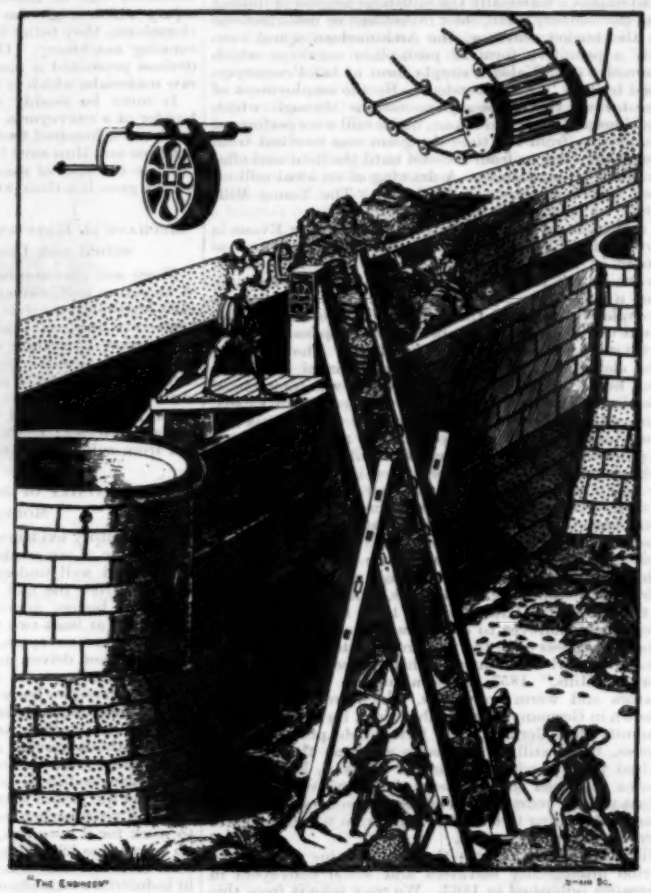


FIG. 3—BUCKET ELEVATOR, 1578 (BESSON)

[1] Newcomen Society, October 12th. Abridged.

is the application of the rollers shown in this detail for the support of the loaded run.

The Introduction of Elevators and Conveyors in Flour Mills.

We next find that the principle of primitive water-handling devices was applied to elevators and conveyors in the first industry which man ever pursued to any great extent, *i.e.*, the manufacture of flour and the handling of grain, at a time when it had ceased to be a domestic drudgery and had become an established industry.

The American millwright, Oliver Evans (1755-1819), by his inventive genius and practical ability, was the first to improve materially the millstone process of milling of the last century. His chief inventions or introductions were the bucket elevator, the Archimedean spiral conveyor, a primitive form of push-plate conveyor which he named "drill," also a simple form of band conveyor, termed by him "the descender." By the employment of these devices the necessary operations through which the various materials had to pass in the mill were performed mechanically, from the time the grain was received from the wagoner's bag or from a vessel until the flour and offal were taken off into sacks. A drawing of an ideal mill on Evans' system is shown in his book, "The Young Millwright," which was first issued in 1795.

A mill built on the lines laid down by Oliver Evans is described in "Duncan's Travels in America" and is recorded in the *Mechanics' Magazine*, July 10th, 1824, from which the following is quoted:—"I have recently visited a mill driven by steam in which manual labour is so completely excluded that the sailor who delivers the grain at the wharf is the last person who applies his hands to it till it descends into the barrel as flour." The invention of the elevators, conveyors, &c., was claimed by Oliver Evans, but was disputed, and a lawsuit was commenced in Baltimore County Court, which was decided in Evans' favour, although it afterwards appeared that he was not the original inventor, for a plate from an old magazine was produced showing sections of a mill in Germany in which elevators and conveyors were in operation at a date many years before that of their introduction into America. An exhaustive search through the German milling literature available at the Patent Office Library reveals the following:—Lukas Vohs,[16] in his book published in 1780, makes no reference to labour-aiding machines for handling grain or meal, whilst the treatise of Ernst Christian August Behrens,[17] published in 1789, and that of Joseph Krakovitzer,[18] 1790, likewise contains no reference whatever to elevators and conveyors, either in the letterpress or in the numerous plates in the former work. Dr. Carl Hartmann, in his "Treatise on Anglo-American Mills," 1857, gives a minute description of elevators and worm conveyors, which were practically unknown in Germany, even at that time, for in the preface he admits that German mills have made practically no progress, being still at the same stage as they were a hundred years previously, whereas England, France, and America reformed their systems and equipments during the last twenty years of the eighteenth century. It would be most interesting to trace the book from which the plate referred to above was taken.

William Fairbairn[19] was the first in this country to describe intelligently elevators and worm conveyors in his treatise published in 1863. We may take it from this that labour-saving devices of the millwright's type made their appearance generally in British flour mills somewhere about 1850, although they were in use, sporadically, as early as 1816.

Introduction of Handling Machinery in Gasworks, Power-houses, &c.

A perusal of the *Journal of Gas Lighting* from the date of its first appearance in 1849 should furnish a reliable record of the progress made in this direction. During the first thirty-one years (1849 to 1880) of its existence, however, we find no mention of elevators or conveyors in the index of this journal. On February 15th, 1881, there is unmistakable evidence that the then existing methods of manual handling were not all that might be desired, for Mr. V. Wyatt, constructing engineer of the Gas Light and Coke Company, contributed an article on the subject which forms a fitting prologue to the introduction of labour-saving devices. He asserted that the handling problem in gasworks was as essential to modern practice as the manufacture of gas itself; he illustrated his article by citing the progress made at the gasworks at York, Newcastle-on-Tyne, and Beckton. He solved, however, only part of the problem by advocating, in addition to a more advantageous lay-out of the works, a system of sidings and inclines by means of which a train of coal wagons could be taken into the retort house. Conveyors and elevators at that time were apparently not yet considered an essential part of a gas plant.

The first article to appear in the *Journal of Gas Lighting*, actually advocating the use of mechanical conveyors in gasworks, was published in the issue of March 18th, 1890. It was written by Norton H. Humphreys, M. Inst. C.E. He, as Wyatt had also done, harped on the labour troubles, and said that the greater part of the wages as set forth on the weekly labour wages sheet were for the simple conveyance of material: coal wheeled into the retort-house, coke wheeled out; coal put into the retorts and coal extracted therefrom, &c.

A committee was appointed in 1888 by the Bolton Corporation for the purpose of visiting different gasworks where labour-aiding devices had been installed, and the conclusion arrived at was that a good system of coal elevating and conveying was the most profitable solution for economising labour.

We may, therefore, date the advent of handling devices in gasworks, including also the first hot coke conveyors, from about 1890, *i.e.*, about forty years later than their introduction into the milling industry. Collieries and power stations began to install such machines at about the same time.

Conveyors as Feeding Devices to other Machines.

We have already seen that practically all types of the conveyors we use to-day were well known in a more or less primitive form eighty or more years before the industries generally were ready for them, as practically no conveyors were employed as independent handling units between 1800 and 1870, except those primitive devices in flour mills already mentioned. They were in fact in advance of their time. Such devices were, however, employed for feeding and delivery purposes, forming integral parts of many machines that came into use at that period. The use of diminutive conveyors and elevators might be said to constitute a transition period before their installation as separate units of more extensive dimensions. Such devices were introduced about the period 1790 to 1870 and some are still used in the same way to-day. The purpose for which such small conveyors, rarely longer than 3ft., were introduced was to keep the labourers out of harm's way and protect them from injury which might be caused by their carelessness and clumsiness, they being in ignorance of the dangers of fast-running machinery. On the other hand, such feeding devices promoted a more uniform rate of supply of the raw materials, which is unquestionably also essential.

It must be readily understood that the designer or builder of a conveyor a yard long could equally well have built one a hundred feet long to bring the material to the machine and thus save hand labour, but this was not done because the cost of manual labour was then so low that no one gave it a thought.

Mechanical Handling of Material in Situations which are Inaccessible to Workmen.

There was also another early application of most types of elevators and conveyors before their employment for their legitimate purpose, for we find that during the period 1800–1870 material handling devices were installed for the purpose of dealing with objects or materials in situations which were inaccessible to workmen. For instance, conveying material slowly through heated retorts, chambers, ovens or furnaces, as in gas and other chemical works; for biscuit and bread making; as Lehr conveyors in glass factories; chain-grate stokers, &c.; also for raising soil from submerged areas.

The Affinity of Some Primitive Motors with Modern Conveyors.

Contributory evidence to prove that the principle upon which some of our modern conveyors are constructed was known and well understood at an earlier date may be gathered from the fact that motors actuated by animals or human beings, apart from gins and other well-known devices, in at least two cases were on the same underlying principle as conveyors, or might have been conveyors had they been driven instead of being made to drive.

In Eckhard's motor of 1795 the familiar moving platform is reversed, a horse or ox driving the platform whilst it itself remains stationary; and in Bottomley's engine of 1814 the motive gear is an endless ladder up which men climb without moving as on a treadmill. The object in mentioning these devices is to show that the technical knowledge needful for building conveyors was not lacking, and that the reason why they were not built and used one hundred years earlier was simply that men were contented to work for a lower wage and that the masters could see no advantage in buying or building conveyors. We may thus attribute the delay in the installation of conveyors in industrial establishments of all kinds to the abundance of manual labour available at that time and to the fact that the quantities to be handled, *i.e.*, tons per annum, were, generally speaking, too small to justify their introduction.

The Latest Developments Fostered by Sheer Necessity.

When making an historical survey of the more modern appliances in use for handling raw materials and merchandise by mechanical means we must realise that handling engineering owes its existence, not only to industrial development, owing to which the quantities to be handled have increased by leaps and bounds from insignificant figures to huge totals, but also in a large measure to the gradually increasing cost of manual labour. It is impossible to employ hand labour to-day, unaided by mechanical appliances, without burdening the cost of production to an extent which must seriously hamper progress. The increased cost of hand labour and its hostile attitude gradually forced the introduction of mechanical elevators and conveyors in gasworks.

One of the devices fostered by necessity was the Hunt automatic railway, invented by C. W. Hunt, in consequence of the strikes of coal wharf operatives at New York in 1871.

The well-known Dodge system of accumulating large piles of anthracite coal was introduced in America in 1885, owing to a strike of the coal haulers at the docks of the Philadelphia and Reading Railway Company at Philadelphia. Another such example was the introduction of the pneumatic system by Duckham. He was compelled, on account of strikes at the Millwall Docks in 1887—which paralysed the unloading of grain vessels—to find other means to safeguard the food supplies. We thus owe the introduction of the pneumatic system of grain unloading in 1891 to its employment as a necessary expedient to frustrate the antagonistic attitude of manual labour. Labour cost and labour troubles are thus directly connected with and responsible for the advent of modern labour-aiding machinery. It is obvious that since the labour question has become chronic and acute, within the last three or four decades, the latest development is a comparatively modern subject, although some of the progenitors of handling devices date back to a very early period.

Few circumstances in the history of invention are more striking to those who philosophise upon its progress than the fact that many of those inventions which have ultimately produced the most marked and decisive results in the march of human progress have been made, tried, laid aside, and for a time consigned to oblivion, and then resurrected from the limbo to which they had been consigned.

[1] "Hydraulic and other Machines for Raising Water," 1842.
[2] "Pneumatica," Second Appendix, Art. IV.
[3] "Le Diverse et Artificiose Machine."
[4] "The Art of Water-Drawing: A Compendious Abstract of all Sorts of Water Machines," 1660.
[5] This illustration is take from "Mundus Subterraneus," Athanasius Kirchner, 1665.
[7] K'ien-Ling Keng Tschi t'u, 1245, the literal translation of which is: Picture of Ploughing and Weaving.
[8] "Histoiré Generalé," Tom VII., 267.
[9] "Theatrum Machinarum," 1724.
[10] "Hydrostatics," Edinburgh, 1672, pp. 298, &c.
[11] "Hydraulic and other Machines for Raising Water," Thomas Ewbank, 1842—footnote on page 149.
[12] "L'Arte di restituire a Roma la tralasciata Navigatione del suo Tevere," Roma, 1685.
[13] "Völlstandige Anleitung Schiff-Häuser oder Arsenale und Anften oder See-Häfen gehörig anzugeben," 1721.
[14] *Mechanics' Magazine*, Vol. 39, p. 309.
[15] "Theatre des Instrumens," Jacques Besson, 1578.
[16] "Milling and Mill Gearing," Augsburg, 1780.
[17] "The Art of Milling," Schwerin, 1789.
[18] "Getraide-Muhlen," 1790.
[19] "Mills and Mill Work," 1863.

RAILWAYS IN MOROCCO.

The only railways as yet existing in the French zone of Morocco consist of the narrow-gauge (60 cm.) military railway running from Marrakesh to the Algerian frontier (with the exception of a break between Fez and Taza) *viâ* Ber-Rechid, Casablanca, Rabat, Salé, Kenitra, Dar-bel-Amri, Meknes, Fez, Taza, Taourirt, and Oujdah, with a branch from Ber-Rechid to Oued Zem, south-east of Casablanca, and another (for military purposes only) from a point between Taza and Taourirt southwards through Mahiridja along the Moulouya valley. The use of this military railway is thrown open to commerce, but the line is quite incapable of dealing with the ever-increasing volume of traffic.

The Protectorate is, however, according to a report by the Department of Overseas Trade, on the eve of being equipped with a normal gauge railway (1.44 m.), as the sanction of the French Government is to be obtained shortly for the issue of a loan of from 600,000,000f. to 900,000,000f., which is to be spent in constructing a line from Marrakesh to the Algerian frontier *viâ* Ber-Rechid, Casablanca, Rabat, Salé, Kenitra, and Petitjean, at which point the metals (yet to be laid) of the Tangier-Fez Railway will be borrowed as far as Fez, whence the line will be carried on again *viâ* Taza, Taourirt, and Oujdah, and linked up with the Algerian railway system. A branch is also to be built from Ber-Rechid to Oued Zem in the phosphate region, whilst a second branch will leave the line at Kenitra and join the Tangier-Fez Railway at Sôk-el-Arba of the Gharb, thus connecting Tangier directly with the coast towns in the French zone. The kilometrage to be constructed (apart from the 210 kiloms. of the Tangier-Fez section) is about 945, whilst the cost has been estimated at from 820 to 870 million francs. There will thus be 1155 kiloms. of normal gauge railways in the zone when the present programme is completed.

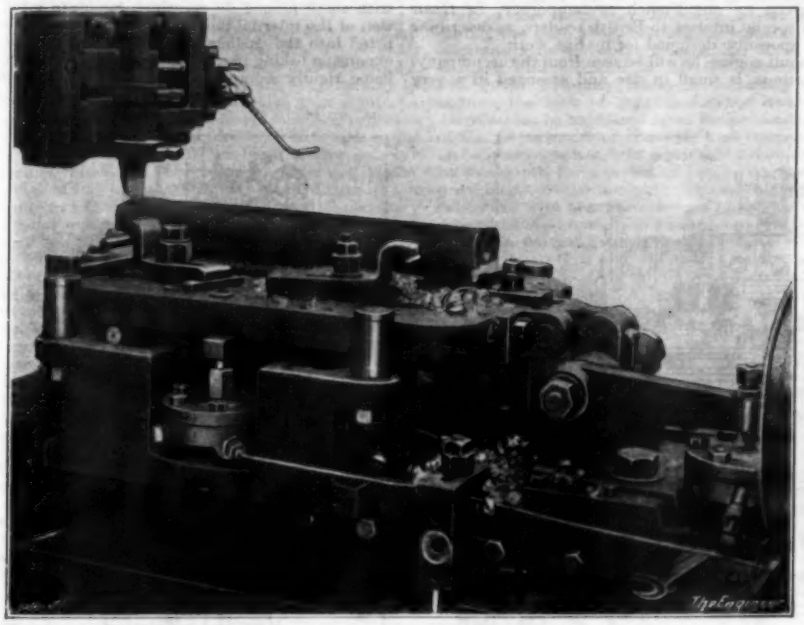
The greater part of the Tangier-Fez Railway, which will run through El-Ksar-El-Kebir, Sôk-el-Arba of the Gharb, Petitjean, and Meknes, is now being worked at, and construction of the permanent way should begin before long.

The question of the electrification of the railway system is still under consideration. To begin with, however, motive power will be supplied by coal-burning locomotives. A quite possible development will be the use of oil-burning engines in the event of a Moroccan oilfield, excellent indications of which have been found, coming into existence.

SOUTH-EAST LANCASHIRE ELECTRIC POWER SCHEME.

The scheme of the South-East Lancashire Electricity Committee to secure the most efficient use of power and of the generating stations suitable for the area known as South-East Lancashire, drawn up at the instance of the Government through the Electricity Commissioners, has been approved. The area covered by the Committee will form the largest electrical unit in the provinces, and includes parts of Cheshire, Derbyshire and Yorkshire, in addition to South-East Lancashire. In Lancashire the following places are included in the scheme:—Manchester, Bolton, Bury, Oldham, Rochdale, Salford, Wigan; Ashton-under-Lyne, Eccles, Heywood, Leigh, Middleton, Mossley, Abram, Ashton-in-Makerfield, Aspull, Atherton, Audenshaw, Billinge, Blackrod, Chadderton, Crompton, Denton, Droylsden, Failsworth, Hurst, Farnworth, Golborne, Hindley, Horwich, Iriam, Kearsley, Lees, Littleborough, Little Hulton, Little Lever, Milnrow, Norden, Orrell, Prestwich, Radcliffe, Ramsbottom, Royton, Standish-with-Langtree, Stretford, Swinton, Pendlebury, Tottington, Turton, Tyldesley, Upholland, Urmston, Wardle, Westhoughton, Whitefield, Whitworth, and Worsley, Barton-upon-Irwell, Bury, Leigh, Limehurst, Wigan and Rixton. In Cheshire the places concerned are Stockport, Hyde, Stalybridge; Alderley Edge, Altrincham, Ashton-on-Mersey, Bowdon, Bredbury, Romiley, Cheadle, Gatley, Hale, Handforth, Hazel Grove, Bramhall, Hollingworth, Knutsford, Marple, Mottram-in-Longdendale, Sale, Wilmslow; Bucklow and Tintwistle. In Derbyshire, Glossop and in Yorkshire Saddleworth are included in the scheme. The scheme has yet to be considered by the municipal electricity committees concerned, by City Councils and other local authorities. There will be a Government inquiry into the proposal on October 31st, and should there be no obstacle to its formation, the scheme will then go forward. It is estimated that this unification scheme will be the means of saving 19,831 tons of coal annually for the next five years, and twice this amount during the following five years. The following generating stations will be shut down as not suitable, namely, Bury (Rochdale-road), Eccles, Glossop (Urban Electricity Supply Company), Heywood, Manchester (Dickinson-street), Radcliffe, Sale, and Stretford (Longford Bridge). The stations to be extended are at Stockport, Ashton-under-Lyne, Bury, Bolton, Outwood, Wigan, Altrincham and Alderley; while new stations are being built or planned at Stockport, Oldham, Kearsley, Wigan, Agecroft, Barton and Carrington.

CUTTER DYNAMOMETER ON A SHAPING MACHINE



A Milling Cutter Dynamometer.

Thanks in a large measure to the experimental investigation of the late Dr. J. T. Nicolson, and to the more recent work carried out at the Manchester College of Technology by Mr. Dempster Smith, much useful information has been obtained for the benefit of engineers on the behaviour of cutting tools, both with regard to their durability and to the forces exerted upon them when operating on various qualities of steel and cast iron. For the purpose of these investigations dynamometers have been evolved for measuring the forces exerted on the tools, and many of our readers will recall the first of these instruments designed by the late Dr. Nicolson, which was described by him in a paper read before the Institution of Mechanical Engineers in 1904. This device had hydraulic supports for the tool to abut against in the longitudinal, horizontal and vertical directions, and gauges were provided to permit of the forces in each direction being observed.

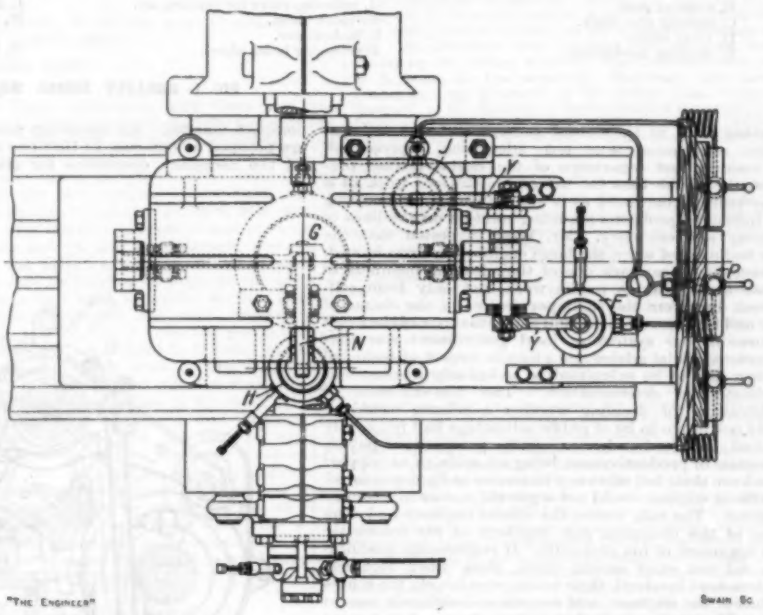
Mr. Dempster Smith has since adapted the same principle to a dynamometer for milling cutters. The machine was completed as long ago as 1914, but for various reasons particulars of the device have not hitherto been available. The dynamometer illustrated herewith is capable of measuring the vertical force exerted in an upward or downward direction at right angles to the axis of the cutter, and a particular feature of it is that the forces indicated do not vary with the position of the work relatively to the milling cutter. The axial thrust on the cutter is measured by mounting the cutter on a floating arbor and reading the thrust by means of a hydraulic support at the end of the arbor.

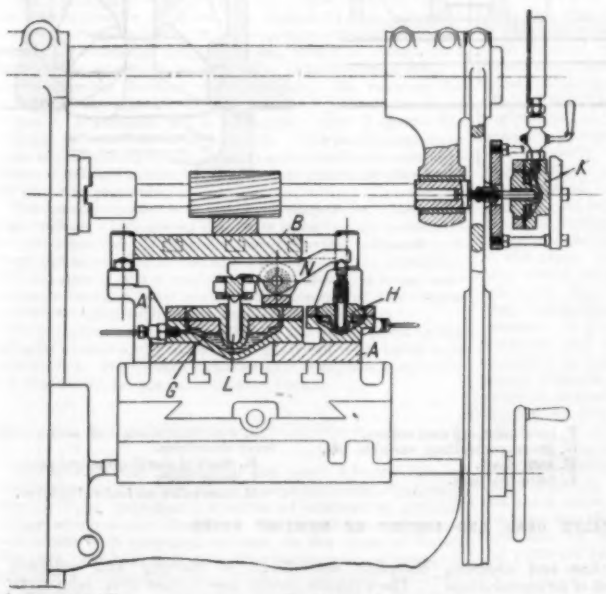
The appliance consists of a supplementary table shown at B in the line engraving, which is carried by levers E fitted to the casting A secured to the table proper of the milling machine. The table B is free to move in a direction at right angles to the axis of the machine spindle, but is prevented from moving laterally by means of four vertical rollers secured to lugs on the casting A. The vertical and longitudinal movements of the table B between the rollers are limited by the four hydraulic supports F, G, H and J, to which it is connected by a system of levers situated under and at the ends of the table. The end thrust on the milling cutter is measured by a fifth hydraulic support K fitted to the stay at the end of the overhanging arm, the arbor being free to slide in its bearings. The longitudinal thrust is thus transmitted to the diaphragm of this support, and is indicated on the gauge connected thereto.

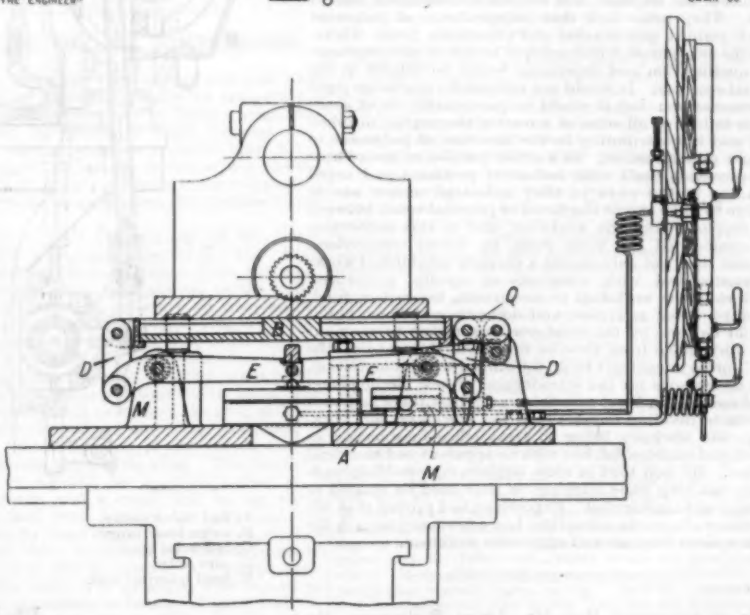
The hydraulic supports G and H take the vertical upward and downward forces on the dynamometer table, the forces being transmitted from the table B to the links D through brackets fixed on the ends of the table and carrying the fulcrum pins. The links D are pin jointed to the levers E which swivel on brackets M on the casting A. The ends of the levers E bear on the knife edge of the hemispherically ended thrust pin L, which transmits the upward force on the table B to the hydraulic support G, the force being indicated on the pressure gauge P. The downward force on B is transmitted by the lever N, and a plunger to the hydraulic support H. The lever N swivels on a pin carried in a bracket secured to A, and has a knife edge at one end which rests in a groove on the back of one of the levers E and at the junction of these two levers. An initial load is put on the supports G and H by extending the screwed plunger at the end of the lever N by hand. The link Q at the right-hand end of the table transmits the horizontal force to the bell-crank levers Y mounted on a bracket on the main casting A, and thence to the supports J and F, which take respectively the forward and backward thrusts on the table A.

The hydraulic supports consist of a main casing fitted with a diaphragm of three-ply rubber insertion, which is secured by a ring. The diaphragm is provided with a central thrust block and nut. The chamber is filled with distilled water. With the liquid practically air free the diaphragm can only deflect by the amount necessary to supply the increased volume of the Bourdon tube caused by the added load, and as the diaphragms are of ample area the depression is only about one-hundredth of an inch. The friction errors in the dynamometer are reduced to a minimum by providing knife-edge contacts between the plunger and levers and by the use of ball bearings at the lever fulcrums, while friction between the table B and its four rollers is practically eliminated by copious lubrication.

It should be explained that in the construction of this dynamometer at the Manchester College of Technology it was necessary to make use of such materials and hydraulic supports as were available. Hence the finished appearance of the appliance is not such as would be looked for in a machine made for sale.







"The Engineer" Swain Sc.

Manchester Association of Engineers

On Friday last, the 7th inst., Mr. Fred. J. West, M.I. Mech. E., president of the Manchester Association of Engineers, gave his inaugural address. Referring to municipal engineering, Mr. West said that, despite the dependence upon the skill, ingenuity, and inventiveness of the engineer for the solution of municipal problems and development of schemes, it was to be regretted that, in the actual management of municipal affairs, engineering was not adequately represented. The training and experience of the engineer were pre-eminently of the best for the administrative work of a municipality, concerned as it was with many engineering and industrial problems requiring solution on the lines of economy and efficiency. Mr. West suggested that the time had arrived when the large engineering firms in each district should earmark one of their leading members to devote some time to public work, not only from self-interest, but from the right perspective of the claims of civic and loca lgovernment, and added that one of the worst features in our system of local government was that competent official advice and plans in respect of technical matters had to be submitted to technically incompetent administrative determination. The non-existence of qualification for deciding whether a scheme would or would not prove to be of public advantage had frequently resulted in good schemes, with prospective paying economies or productiveness, being set aside, or so crippled as to have their full efficiency in service sadly depreciated. An official engineer could not argue the matter in a council chamber. The only voices the official engineer had were those of the chairman and members of his committee who approved of his proposals. If engineering qualification did not exist among them, then, when technical matters were involved, their voices were largely the echoes of that of the engineer, and sometimes indifferent ones at that. They must lack that independence of judgment which trained qualification and experience gave. Therefore the incorporation in municipal bodies of such engineering qualification and experience would be helpful to the official engineer. It would not necessarily guarantee right determination; but it would unquestionably be of assistance in having all sides of a matter thoroughly threshed out, and in contributing to the direction of judgment to a right determination. In another portion of his address the president dealt with industrial problems and urged that one of the ways to allay industrial unrest was to restore to some extent the direct or personal touch between the employer and the workmen, and in this connection he commended the work done by works committees. He said that, not only should a properly established works committee deal with questions of specific grievances, comfort of the workshop or mess-room, benevolent fund, holidays, social activities, and domestic questions, but it should be used by the employer as a means to acquaint the workpeople from time to time with the state of the firm's order or contract book, the difficulties of competition, and the reasons for the introduction of new methods and machinery. Mr. West said that in the past there had been a definite dividing line between the office and the workshop, the tendency being to treat office information as secret and confidential, but with no apparent and beneficial reason. He said that in most engineering establishments there was very little information that need be treated as private and confidential. Experience had proved that the existence of a works committee had a tendency to curb the over-zealous foremen and aggressive workmen.

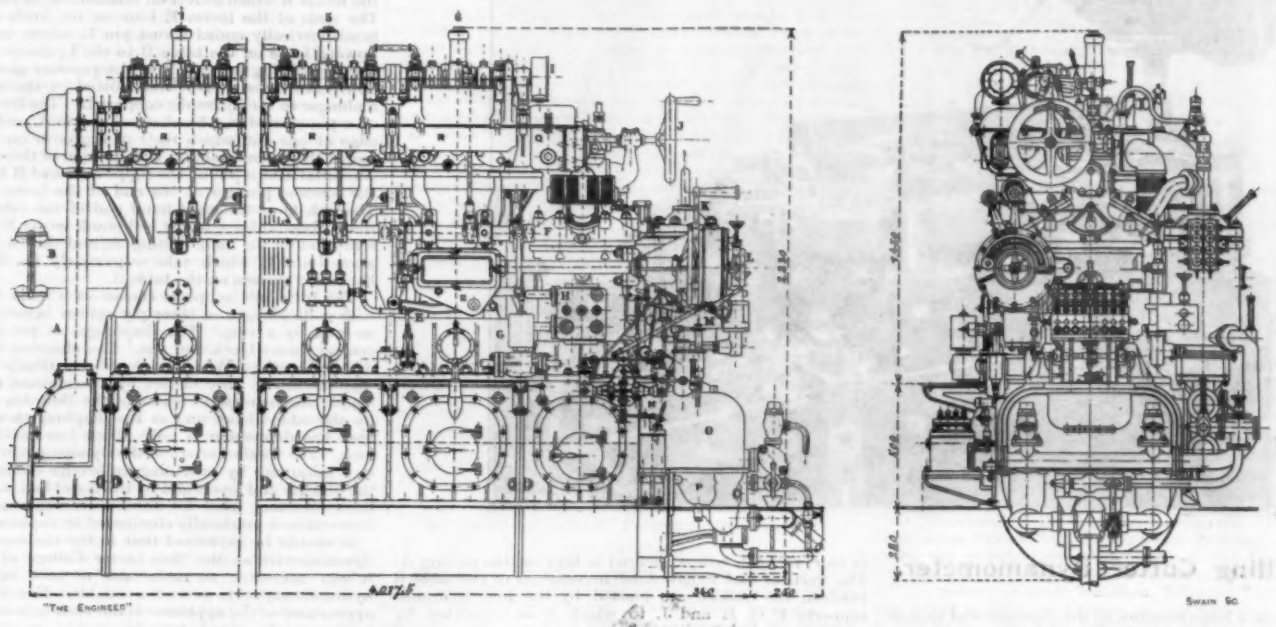
It is announced that Mr. James Williamson, the assistant engineer to the Cambrian Railway Company—which is one of the constituent companies of the Western group—has been appointed the engineer of the Festiniog Railway, which is outside the Railways Act.

Renault High-Speed Diesel Marine Engines.

The following account of the Renault Diesel engine, recently given by our French contemporary, *Le Génie Civil*, is of special interest to British readers, as describing an engine specially designed for marine work.

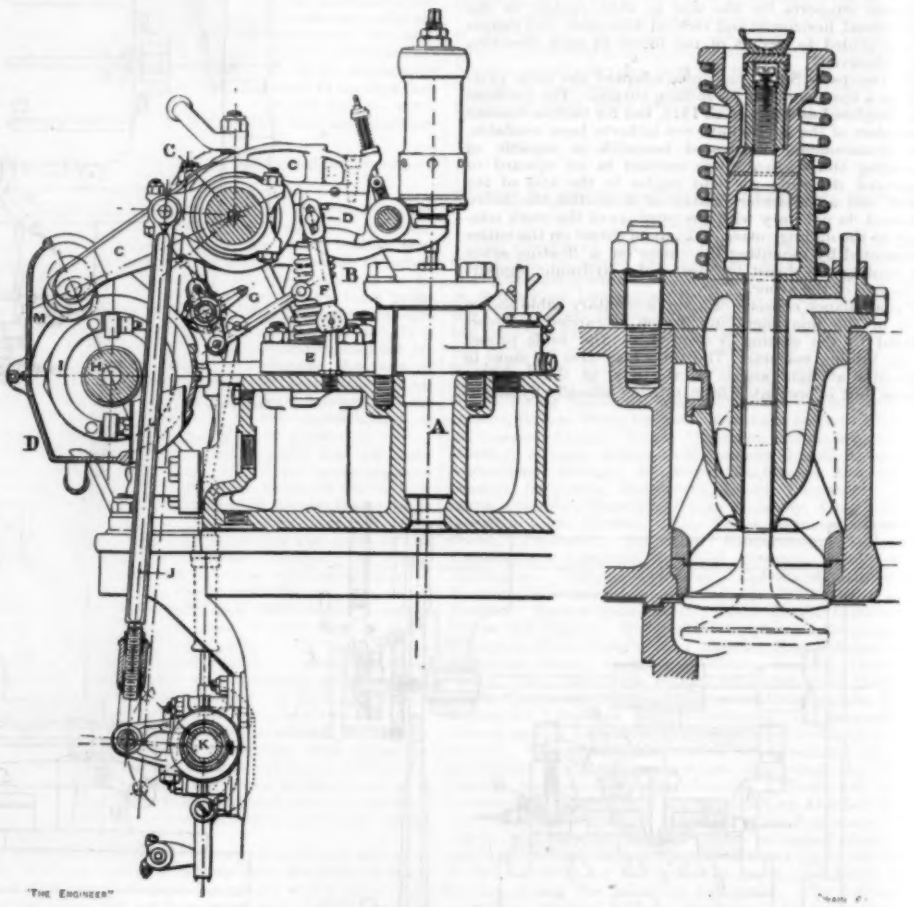
The Renault engine, as will be seen from the accompanying illustrations, is small in size and arranged in a very compact manner. All operating gear and control levers are grouped at one end, so that one attendant may effect all the necessary operations for starting, running, and reversing. It has six cylinders in line and develops 300 brake horse-power at a normal speed of 500 revolutions per minute. The cylinder casings, which are of cast steel in pairs, are mounted on a cast steel bed-plate made in sections rigidly bolted together, which also serves as a crank case. This case is fitted with large inspection covers, which permit of the ready examination and easy dismantling of the connecting-rod bottom ends. On the front side of the engine the inspection covers are provided with small hinged doors, which facilitate rapid examination of the internal parts. Cylinder liners of cast iron are fitted into the casings in such a manner as to permit of expansion taking place in a downward direction, the liners being rigidly secured at the top, with the usual bottom ring arrangement to prevent leakage of cooling water. The two outer cylinders carry auxiliary gear, No. 1 cylinder carrying the vertical shaft and No. 6 the complete assemblage of starting and reversing gear.

The cylinder covers are of cast iron, each cover being provided with a fuel valve, air, exhaust, and starting valves



A, vertical shaft.
B, exhaust pipe.
C, starting gear shaft.
D, lever shaft.
E, starting mechanism.
F, compressor.
G, reducing valve for starting air.
H, valve chest.
I, tachometer.
J, reversing hand wheel.
K, starting levers.
L, hand wheel controlling variable lift.
M, lever with segment, controlling the ignition oil pump.
N, ignition oil pump.
O, oil and water pump casing.
P, water pump.
Q, reversing gear mechanism.
R, cam case.

FIG. 1—RENAULT DIESEL MARINE ENGINE



A, fuel valve casing.
B, valve lever tappit.
C, fuel valve lever.
D, cam roller.
E, fixed spherical stud.
F, lever carrying cam rollers.
G, lever controlling variable lift.
H, cam shaft.
I, main fuel cam.
J, rod controlling fuel and starting lever excentrics.
K, shaft of starting control gear.
L, lever shaft.
M, cam roller on fuel valve lever.

FIG. 2—VALVE GEAR AND SECTION OF EXHAUST VALVE

and also a safety valve. The cam shaft is made in sections and may be quickly dismantled. The cams themselves are completely enclosed in a light aluminium case fitted with a removable cover and run in an oil bath. The fuel cam is specially designed so that it can be adjusted to obtain any desired degree of advance in the point at which the fuel is injected into the cylinder.

The valve levers are made in cast steel and are fitted with specially hardened steel cam rollers. The shaft which operates the valve levers is made also in sections, so that when dismantling the engine each cylinder may be lifted independently along with its valve gear complete.

The necessary air for combustion is entrained on cylinders one and six, through pipes provided with slits and on the intermediate cylinders through enclosed spaces between the cylinders, which are covered with perforated plates. The problem of fuel injection has been studied with a view of obtaining at all loads the exact amount of oil necessary for the load at which the engine is running. The fuel valve, as we shall see later, is of the variable lift type, and the injection pressure, as well as the fuel pump pressure, is regulated automatically. In order to enable heavy fuel oils to be utilised a system of pilot ignition is adopted, a supplementary fuel pump being fitted for the light ignition oil. The light oil is also used when the engine is running at light loads. During the operation of starting the fuel pumps are automatically controlled, and when the engine is on normal load regulation may be effected by a large hand wheel. An emergency governor which operates directly on the fuel pumps is also fitted. The pumps are so arranged that the stroke of each may be varied individually whilst the engine is running; thereby a very flexible control is secured. Test cocks are fitted on the fuel pipe line, near the fuel valve on the cylinder covers, which enable the attendant to ascertain at any time exactly how the pumps are working. The pump plungers are not provided with stuffing-boxes. The engine is started with a minimum quantity of compressed air. Starting valves are fitted to each cylinder, air being admitted to all the cylinders until the engine attains the normal speed. The starting mechanism is so arranged that when the normal speed is reached three cylinders are put on fuel, then six cylinders on fuel, with the starting air completely shut off. These operations are automatically controlled throughout. The starting and reversing mechanism is so interlocked and controlled that no false start can be made, and the whole of the operations necessary can be carried out by one attendant. Running at a normal speed of 500 revolutions per minute the engine can quite easily be reversed in five to six seconds.

The pistons are of special cast iron, the piston crown being supported by six ribs and the design in general suitable for high-speed working. The connecting-rods are of forged steel with separate top and bottom ends, steel liners being provided so that the compression may be adjusted. The crank shaft and connecting-rod top and bottom ends are all fitted for forced lubrication.

The system of forced lubrication is very complete, the pressure and temperature of the oil being capable of variation to suit the load at which the engine is running. An oil cooler is fitted and thermometers are provided both in the intake and outlet sides. The lubrication of the main cylinder is effected by a central lubricator with visible feeds at all points. All other parts of the engine, such as gears, cams, shafts, levers, &c., are linked up to the forced lubrication system through a connection taken from the main oil distributor in the crank case. The cooling water is delivered to the cylinder jackets by two water circulating pumps of ample capacity. Thermometers are fitted to each cylinder cover so that the temperature of the cooling water may be noted. The variable lift of the fuel valve is obtained by means of the patented mechanism shown in Fig. 2. The ordinary lever C receives a fixed lift from the main fuel cam, which is transmitted through the intermediate cam roller D to the small lever B which operates the fuel valve directly. By varying the position of the roller D between the two jaws of the lever B and C a variable lift is obtained. Fig. 2 shows the position of cam D for minimum lift. The position of these cams is determined by a system of levers and links operated from a shaft G common to all cylinders and controlled from the starting platform.

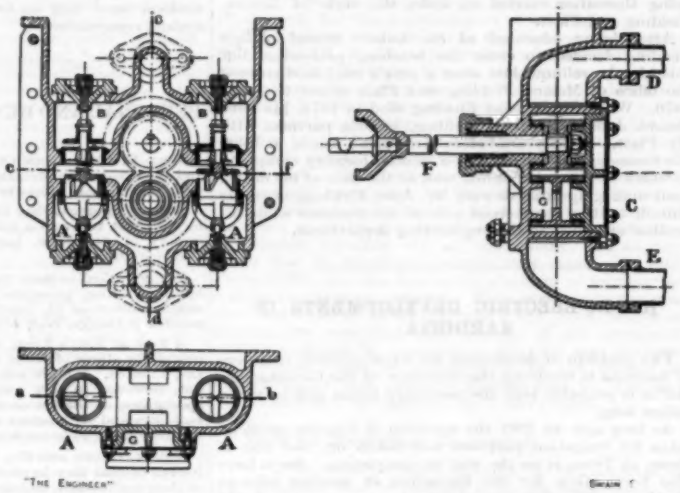
The air compressor is of the three-stage type, fitted with plate valves, which are so placed as to be readily accessible for examination. Intercoolers are provided between each stage and safety valves are also fitted to prevent accidents. The exhaust is water cooled, the exhaust pipe being supported in such a way that the alignment of the engine is not interfered with by expansion.

To permit of easy examination of the upper parts of the cylinder covers and gear a small platform with hand rails is provided. Both main cylinder and compressor cylinder are fitted with bosses for indicator cocks.

The special Coal Number of the *South African Mining and Engineering Journal*, which was published in Johannesburg in July, contains a number of interesting articles, among which is one describing the possibilities of a new port which it is proposed to form on the coast of Natal. The port, on which it is said some capitalists are prepared to spend 8 millions sterling, would be specially equipped for handling coal. The most probable site is Richards Bay, at the mouth of the Umhlatuzi.

THE REFRACTORY MATERIALS RESEARCH ASSOCIATION.

Speaking at the annual meeting of the Institution of Gas Engineers on October 11th in connection with the work of the Refractory Materials Research Association during the past year, relating to jointing materials for refractories for gasworks retorts, Mr. A. E. Broadberry, engineer and manager of the Tottenham Heat, Light and Power Company, made some strong remarks concerning the lack of support for the Association. The Association, he said, had been formed under the scheme of the Department of Scientific and Industrial Research, and a guarantee had been given that a sum of £2500 would be subscribed for a period of five years, the Department providing a similar amount. The steel makers were more concerned with this than the gas industry, but in neither case had the support been forthcoming which should have been. In the first year of the existence of the Association only £1700 had been subscribed, and there was the prospect, if not the absolute certainty, that the Government support would be withdrawn. What a disastrous thing that was, and a disgrace to national effort. It was a shame to feel that manufacturers and users alike should have failed to support the Association. Users were surely concerned. Was the quality of the fire-brick now obtainable so good that they thought no research was necessary? That was certainly not so, and he suggested that users would benefit to the extent of thousands and thousands of pounds per annum by helping to improve the quality still further than it had been improved by the limited efforts so far made. Although the steel industry was interested to a far greater extent than the gas industry, was the latter doing all that it could in the way of financially supporting this research work? The Institution subscribed £150 per annum, and the amount seemed ridiculous. It only represented about £1 for every £10,000 spent in repairs annually on retorts and furnaces in gas and steel works. It was not for him to suggest how the financial position of the Research Association could be improved, but it might be done by districting the country and assessing the amount to be raised from each district, or a levy might be made per ton of clay work. It was a most important thing that this work should be carried out, and it was to be hoped that some steps would be taken to secure the whole-hearted support of manufacturers and users alike.



A, suction valve; B, delivery valves; C, pump cover; D, delivery pipe; E, suction pipe; F, pump shaft; G, pump gears.

FIG. 3—LUBRICATING PUMP

A FUSIBLE PLUG FOR AIR COMPRESSORS.

A system of protecting air compressors and pipe lines from the effects of an abnormal rise in the temperature of the air, which involves the use of fusible plugs, has been devised by Mr. W. Smith, of North Circular-road, Kimberley, South Africa, and has recently been fitted to an installation there. When the device acts it has the effect of shutting off the supply of steam to the compressor engine and, at the same time, releases the overheated air from the mains.

A butterfly valve is used for shutting off the steam supply, while a mushroom valve releases the air. Both are operated by high-pressure air taken from the main system. At any point, such, for instance, as the outlet from the compressor, where an excessive air temperature is likely to develop, a special form of fusible plug is inserted in the pipe. The plug is so designed that when the soft alloy melts, on account of a rise in temperature beyond the safe limit, the alloy is not projected into the outlet of the plug, but is trapped in a pocket, so that the air has a clear passage. A ¼in. pipe is used to connect the plug with the butterfly and mushroom valves, and a by-pass cock is provided in order that the action of the valves can be tested without affecting the fusible plug. The butterfly valve is actuated by a small air cylinder, bolted to a bracket on the outside, and a crank arm on the valve spindle. A lever and wire lanyard are provided for re-setting the valve by hand when the engine is started up. The mushroom valve is opened by the air pressure under a piston which is slightly greater in diameter than the valve itself. The valve is so arranged with regard to the pipe line that it is unlikely to become clogged with oil entrained by the air, and re-sets itself by gravity when the pressure has been released. The proportions of the alloy for the fusible plug which are recommended are 9 of tin to 1 of lead for two-stage compressors, and pure tin for single-stage machines.

ELECTRIFICATION OF THE CHILEAN STATE RAILWAY.

We are informed by the Westinghouse Electric International Company that it has received final confirmation of the contract to supply the equipment to electrify the Chilean State Railway between Valparaiso and Santiago, and the Los Andes branch. This contract covers the most important railway electrification undertaken since the beginning of the war, and the largest ever undertaken by an American firm outside of the United States. The main line, which is 116 miles long, is now under steam operation. It connects Valparaiso with Santiago, while the line to Los Andes is 28 miles long, and forms the Chilean State Railway section of the transcontinental line to Buenos Aires. The value of the contract is 7,000,000 dols., and included in the equipment are eleven local passenger locomotives, fifteen road freight locomotives, six express locomotives, seven shunting engines, and five sub-stations of 4000 kw. each. Current will be supplied at 3000 volts direct current, and there will be five sub-stations, each of 4000 kilowatts capacity.

Owing to the abundance of water power in Chile, and the high price of fuel, all of the Chilean railways will eventually be electrified, and the present project is the first step in this progress. Other American concerns which received contracts for requirements of the Chilean Railways are the American Locomotive Company, the Pressed Steel Car Company, and the Anaconda Copper Mining Company. The Errazuriz, Simpson Company of Chile, Chilean agents of the Westinghouse Electric International Company, will build the overhead construction.

Water Gauges.—A substantial form of water gauge, for measuring draught or similar moderate differences of pressure, is being brought out by Messrs. Walker, Crosweller and Co., of 265, Strand, London, W.C. 2. It is known as the "Full Scale" gauge, on account of the fact that the rise or fall in the level of its water is approximately equal to the difference between the pressure being gauged and that of the atmosphere—with an ordinary U tube the rise or fall is, of course, equal to half the difference. This effect is produced by arranging a large reservoir of water at the end of the gauge tube which is open to the atmosphere. This reservoir is cast in one piece with the frame of the gauge, and is either at the top, the bottom or midway, according to whether draught, pressure, or draught and pressure are to be measured. Several gauge tubes can be arranged in one frame for giving separate readings.

Institute of Transport.—About 240 members and guests sat down at the second annual dinner of the Institute of Transport, held at the Hotel Cecil on the evening of Monday, the 10th inst. The President, Lord Ashfield, took the chair, being supported by Sir Henry Maybury, the President-elect, and Mr. H. E. Blain, the hon. secretary. The toast "The Institute of Transport" was proposed by Mr. Arthur Neal, Parliamentary Secretary to the Ministry of Transport, and responded to by the President. During the course of his reply, Lord Ashfield said that the Institute had now over 1000 members and 300 graduates and students. He also said that the Institution of Electrical Engineers had been good enough to allow the Institute of Transport to share its home. Mr. Honoratus Lloyd proposed "The Transport Industry," to which Sir Henry Thornton replied; "Kindred Institutions" was proposed by Sir Henry Maybury, and responded to by Captain Riall Sankey (President of the Institution of Mechanical Engineers) and Mr. J. S. Highfield (President of the Institution of Electrical Engineers). Mr. E. S. Shrapnell Smith gave "Our Guests," to which Major-General Sir F. H. Sykes replied. The Lord Mayor of Manchester, Alderman William Kay, was present at the dinner, and should have also responded to the last toast, but owing to the lateness of the hour was unable to do so.

Public Contracts Placed Abroad.—The principal argument advanced against the placing of public contracts abroad at the present time is, says the *Bulletin* of the British Engineers' Association, that in most cases the amount saved would be almost, if not entirely, swallowed up by unemployment relief and loss of income tax on the contractors' profit. In all probability, this will be the result in the case of the London County Council's turbo-generator. It has been stated officially that the Swiss tender was about £8000, or 16 per cent., less than the lowest British tender. Therefore the British and Swiss prices must have been £50,000 and £42,000 respectively. If the total wages at all stages of manufacture, from raw materials upwards, were 80 per cent. of the British price of £50,000, they would amount to £40,000, which, on the basis of an average weekly wage of £4 15s., would employ 324 workpeople for six months. If unemployed, these people would have to receive from one public source or another an average amount of at least 20s. per week to keep them alive. The unemployment relief on that scale would therefore absorb £8424, or more than the total saving effected by placing the contract abroad. Assuming that the British contractor, when selling at £50,000, made a profit at the rate of 10 per cent., it would amount to £4545, the income tax on which, at 6s. in the £, would amount to £1363. It is, therefore, more than probable that the community as a whole will gain nothing whatever financially by the acceptance of the lower foreign tender, whilst the moral loss due to the substitution of unemployment relief for workers' wages will be incalculable.

Engineering Golfing Society.—The Autumn Meeting of the Engineering Golfing Society was held under ideal weather conditions at Sandy Lodge, on Tuesday, the 11th inst. The meeting, at which there were fifty competitors, was a success in every way, and, as usual, the arrangements made by the hon. secretary and his staff were most excellent, everything working without a hitch, other than that caused by some members taking a wrong train, and arriving late. In the morning there was an 18-hole medal round for the "Hele-Shaw" Scratch Challenge Cup and Memento and other prizes. The Scratch Prize was, as on many former occasions, taken by Captain C. H. Hayward with a score of 77. In the First Division for players with handicaps up to 10 there was a tie between Mr. A. F. Patey (85 − 6 = 79) and Mr. F. R. Phipps (89 − 10 = 79), who will play off for the first and second prizes. In the Second Division for players with handicaps of 11 and over, the first prize was won by Mr. H. L. Williams, with a score of 91 − 11 = 80, and the second by Mr. B. J. Hall, with 93 − 12 = 81. The prize for the best score made in the first 9 holes under half handicap was won by Mr. G. Midgley Taylor, with 44 − 4 = 40, and the prize for the best score in the second 9 holes by Mr. C. S. Davidson, with 43 − 5 = 38. As a matter of fact, Mr. Patey's score for the second 9 holes was two strokes less than that of Mr. Davidson, but members are precluded by the rules of the Society from taking more than one prize—other than the scratch prize—and Mr. Patey had already taken the prize mentioned above. In the afternoon there was a round of foursomes, 18-hole match play against bogey, for the "Hadfield" Challenge Cups and Mementoes and other prizes. The cups and mementoes were won by Captain C. H. Hayward and Colonel J. C. Hearson, who were "all square." For the second prizes there was a triple tie between Messrs. C. R. D. Pritchett and J. L. S. Vogel, Messrs. L. Trewby and A. Valon, and Messrs. R. E. Doowra and J. F. Hasseldine, who were all "three down," and will have to play off for the prizes.

Books of Reference.

South African Engineers' Electrical and Allied Trades' Directory, including Mining Directory, 1921–22. London: The Argus South African Newspapers, Limited, Byron House, 82–85, Fleet-street, E.C. 4. Price 30s. net.—The present issue of this directory is much larger than its predecessor. It is the only work of its kind which covers the whole Union of South Africa. Every branch of engineering is embraced, and the whole *personnel* of the various trades is classified alphabetically and geographically, while numerous cross indexes add to its usefulness. The particulars given in the alphabetical section include complete postal, telegraphic and cable addresses, telephone numbers, the names of partners (if any), and the agencies represented. In the case of companies, the directory gives details of capital, names of directors and other information that will afford a correct idea of their business position and importance. In the geographical section the firms are given in the different centres throughout South Africa, and a complete and authoritative list of the businesses in each town falling within the scope of the work is provided. The overseas agencies held by the South African firms comprise over 1500 items, and will be found very useful. The "Buyers' Guide to Engineers' Specialties" comprises a long list of classified trades. The different sections are marked by the use of a coloured card, which extends beyond the gauge of the printed page, thus enabling the user to turn to the required section at once.

The A.B.C. Motor, Marine and Aircraft Guide, 1921. (Where's Where). By W. C. Bersey and A. Dorey. London: The Red Book Publishing Company, Limited, 1, Gough-square, Fleet-street, E.C. 4. Price 7s. 6d. net.—In the ordinary course of events, the user of a directory or railway guide does not know where to put his finger on the information he requires. The authors of the "Guide" attempt to overcome all questions in relation to transport in all its phases. Primarily intended to serve the motor user on land, by water or in the air, and whilst the word "railway" does not appear in its title, the volume contains the names of railway companies which serve some four thousand stations in the United Kingdom. Over 4600 towns and places, in strict alphabetical order, are dealt with. A counties index has been introduced in order to supply wider local information, whilst for air navigators an air navigation index is supplied, which affords complete reference to the Air Ministry's Orders. Speed limits are given for the whole of the United Kingdom in the actual wording of each enactment, with the date and reference of the enactment. In the case of air navigation, all prohibited areas, signposts, warnings, &c., are given under each place to which they refer in the actual wording of the Orders as issued by the Air Ministry.

North Staffordshire, its Trade and Commerce, 1921. The official handbook of the North Staffordshire Chamber of Commerce. Edited and compiled with the authority of the Chamber by the secretary, Arthur P. Llewellyn. Derby: Bemrose Publicity Company, Limited, 25, Midland-place.—This volume is on the same lines as previous volumes connected with other Chambers of Commerce. The industrial progress for the last decade is reviewed. The effect of the war on North Staffordshire was not entirely adverse, but whilst other trades greatly enlarged their works to increase production, the pottery trades had no great call on their resources. The bulk of the business which went on during this period was on account of civil orders. Under these conditions not only was the trade maintained intact, but new markets were developed, and exports were kept up to a level which, under the circumstances, was remarkable. In the year 1913 the shipments of pottery totalled over 202,000 tons of a value approximately of £3,400,000; in 1919, 66,454 tons, of a value of £3,718,774; and in 1920, 203,181 tons, valued at £7,937,799. From these figures it will be seen that the industry is maintaining its overseas trade at a high level. An endeavour has been made to reorganise the pottery trade on a sounder basis than heretofore. With this end in view the whole of the manufacturers' associations have been united to form the British Pottery Manufacturers' Federation. This Federation not only deals with the economic aspect of the trade, but is endeavouring to promote technical, artistic, and educational development. The last decade has seen real and substantial progress. The reputation of Staffordshire pottery never stood so high. The railway and canal transport is dealt with in a special section, and a coloured map is included in the new issue. The coloured section devoted to Staffordshire pottery is admirable. There is also a classified trade index and a trade mark section.

The Motor Car Index, 1921. Compiled by J. F. Atkinson. London: J. F. Atkinson and Co., 31, Essex-street, Strand, W.C. 2. Price 10s. net.—Here is a book of about 250 pages giving details pertaining to all cars made or sold in this country during the last ten years. A separate section is devoted to 1921 models. The directory is comprehensive and complete and gives information regarding both British and foreign motor car makers, concessionnaires, and agents, and also the makers' chassis numbers.

Department of Scientific and Industrial Research: Red Books of the British Fire Prevention Committee, Nos. 221 and 231, Fire Tests with Floors. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 2s. 6d. net each.—Report No. 221 deals with fire tests carried out upon concrete floors. The test pieces were reinforced concrete floors, comprising a furnace clinker reinforced concrete slab and a coke breeze reinforced concrete slab. Report No. 231 deals with tests carried out on reinforced concrete floors, comprising a Thames ballast reinforced concrete slab (with coke breeze protection to the soffit), a Trachyte reinforced concrete slab (retest), a Buxton limestone reinforced concrete slab, and a Shap granite reinforced concrete slab. Full details and particulars of these tests, with diagrams and pictures, are given.

Obituary.

JAMES FIELDING.

The death took place on Tuesday night of Mr. James Fielding, Atlas Ironworks, Gloucester, after a brief illness. Mr. Fielding was in his seventy-fifth year, and his death occurred on the eve of his golden wedding.

Mr. James Fielding, who was the elder son of the late Mr. Samuel Fielding, was born in Lancashire. His father went to Gloucester in October, 1855—when James was about nine years old—and was engaged with Messrs. William Eassie and Sons, railway contractors (the predecessors of the Gloucester Railway Carriage and Wagon Company, Limited). Mr. Samuel Fielding afterwards became a partner with Mr. John Gillett, of the Atlas Ironworks, and following Mr. Gillett's retirement, he was joined by Mr. James Platt (who had been manager for Messrs. Savory and Sons, engineers) in 1866, the business being thereafter carried on under the style of Messrs. Fielding and Platt.

After being educated at St. Luke's School, James Fielding decided to enter the teaching profession, but this idea he relinquished after a year's trial, and entered the office of Messrs. Fielding and Platt about the year 1870. When Mr. Samuel Fielding died in 1874, his sons, Messrs. James and John Fielding, became partners with Mr. Platt. Some years before Mr. Platt's death, in 1898, the business was turned into a limited liability company, of which Mr. James Fielding was, at the time of his death, joint managing director with Mr. John Fielding, devoting himself to the commercial side of the business while his brother attended to the engineering department.

HYDRO-ELECTRIC DEVELOPMENTS IN SARDINIA.

The problem of developing the hydro-electric resources of Sardinia is receiving the attention of the Government, and it is probable that the necessary funds will be voted before long.

As long ago as 1907 the question of forming artificial lakes for irrigation purposes was taken up, and one of them, at Tirso, is on the way to completion. Steps have also been taken for the formation of another lake at Coghinas. The first-named lake has a capacity of 416 million cubic metres of water, and the estimated capacity of the second is 254 million, which will place them among the largest artificial lakes in the world. The geological constitution of Sardinia, however, is such that many other great reservoirs could be constructed, on the Flumendoso and the Temo, and at Isili and Cagliari, for instance. It has been estimated that the total capacity of all reservoirs which might be constructed would amount to 1500 millions of cubic metres, from which 100,000 horse-power could be produced, while 100,000 hectares of land might be irrigated. According to other calculations, the Tirso, Coghinas, Temo and Flumendoso hydro-electric plants alone would furnish about 500 million kilowatt-hours per annum, of which one-fourth would be absorbed by local demands for lighting, railway traction, agricultural works, &c., while the remaining three-fourths would serve to give an impulse to electrical and metallurgical industries.

The mining industry of Sardinia, in spite of the disadvantageous circumstances in which it works, is of such importance that its output forms more than a quarter of the entire Italian production. Of zinc alone, 200,000 tons are produced yearly, but the mineral is exported to Belgium, Great Britain and France for manufacture. If hydro-electric power were available, the zinc, instead of being exported and re-imported in the finished state, could be manufactured on the island itself. In the same way the iron ore which abounds might be utilised for the production of pig iron.

INSTITUTION OF MECHANICAL ENGINEERS, NORTH-WESTERN SECTION.

The second function of the new session of the North-West Section of the above-named institution took place on Wednesday of this week, and consisted of visits to two works, viz., to the spinning and weaving mills of Ashton Bros. at Hyde, and to the Hartford Works of Platt Bros. and Co., Limited, of Oldham. Messrs. Ashton's mills cover a very large area, and carry out the complete functions of weaving cloth from the raw material. The members present were invited to inspect the various sections of the mills, which are perhaps the most up-to-date of any on the Manchester area. In the afternoon the members were taken to Oldham to the new works of Messrs. Platt Bros., where, after being entertained to lunch by the firm, the visitors were enabled to inspect some of the principal departments of this vast establishment, which, together with the old works in Oldham, finds employment for about 10,000 persons in normal times. This is the second occasion on which the Institution of Mechanical Engineers has paid a visit to the works of this firm, the last occasion being in 1894, since which date the area of the works has grown very considerably. In welcoming the visitors on Wednesday last, Mr. H. Platt Hall, the chairman of the company, said that the present visit came at an interesting period in the history of the firm, as this year marked its centenary. He said that in 1821 the late Mr. Henry Platt came to Oldham from Saddleworth and set up in business as a textile machine maker with about half a dozen men. In those days machinery was largely made of wood, and although cast iron was just beginning to find its place in the industry, it was comparatively little used. Shortly afterwards, Mr. Platt, who no doubt appreciated the advantages of cast iron, joined in partnership with Mr. Elijah Hibbert, a local ironfounder, and the firm was then known as Hibbert and Platt. As the business progressed, three of Henry Platt's sons were taken into partnership, and the firm became Hibbert, Platt and Sons. Later on, the Platts purchased the Hibbert share in the business, and the firm became Platt Bros. and Co. Two of the brothers Platt (Joseph and James) died comparatively young men, and the surviving brother, John Platt, took several of his staff into partnership, the firm continuing by the same name until 1868, when it became a limited company. In addition to the two large engineering works at Oldham, the firm possesses its own collieries, at which about 1300 men are employed. The visitors were particularly impressed by the foundries, which are capable of turning out nearly a thousand tons of castings a week and are equipped with admirable labour-saving appliances. The roller department is almost unique in this country on account of its size, equipment and output. Another interesting department visited was that for the manufacture of mule carriages. Here the visitors were shown the latest development in this class of machine, viz., the light pressed steel frame, which is expected ultimately entirely to replace the use of timber for this purpose. In the adjacent spindle works some 2½ million spindles and about 54 miles of tin rollers are said to be produced yearly. It was pleasing to note that most of the departments of the works were well employed, and the visitors came away with the impression that Lancashire textile machinery workers were still quite capable of holding their own against competitors.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

John M. Terry and Co. have opened show rooms at 5, 6 and 7, Great Hampton-street, Birmingham, and transferred their Birmingham offices to that address.

We are informed that Captain M. G. Kiddy, who has been for the past two and a-half years assistant secretary of the Society of Architects, has been appointed secretary to the Concrete Institute.

We are asked to state that Phœnix Industrial Services have left 70, Finsbury-pavement, and moved to new and more commodious offices at 12, London-wall, E.C. 2. The new telephone number is London Wall 3374.

A fire at King's Lynn, on Friday last, completely destroyed one of the stores of boxes belonging to Kerner-Greenwood and Co., Limited. We are asked to state that the occurrence will not, however, in any way affect the supplies of the firm's specialities, as the fire occurred some distance from its factory buildings and its reserves of empties are sufficient to meet all demands likely to be made upon it.

Fredk. Brady and Co., Limited, of Petershill-road, Glasgow, inform us that they have recently completed several extensions of their works which include an addition to the engineering shop, 190ft. long by 55ft. span by 30ft. to eaves; a new bay to the heavy tank shop, 225ft. long by 55ft. span by 30ft. to eaves; a new steel bin and furniture department, 270ft. long by 55ft. span by 25ft. to eaves; an addition to the steel window and casement department, 270ft. long by 35ft. span by 25ft. to eaves; and a new roof light, &c., department, 150ft. long by 42ft. span by 16ft. to eaves.

Finsbury Technical College Old Students' Association.—The tenth annual dinner of the Finsbury College Old Students' Association will be held at the Engineers' Club, Coventry-street, on Saturday, November 12th, when the chair will be taken by the president, Professor G. T. Morgan, F.R.S. Old students of the College may obtain particulars from the honorary secretary, H. P. Guy, 209, Northumberland-park, Tottenham, N. 17.

Institution of Naval Architects.—The following scholarships in naval architecture and marine engineering have been awarded by the Council of the Institution of Naval Architects:—Naval architecture: the Fairfield scholarship (£150 per annum), to Mr. A. Mitchell, of Sir W. G. Armstrong, Whitworth and Co., Limited, Newcastle; and the Beardmore scholarship (£150 per annum), to Mr. F. W. Green, of Harland and Wolff, Limited, Belfast. Marine engineering: the Weir scholarship (£150 per annum), to Mr. Edward Steel, of Richardsons, Westgarth and Co., Limited, West Hartlepool; and the Yarrow scholarship (£100 per annum), to Mr. C. R. Cooper, of Harland and Wolff, Limited, Glasgow.

The Association of Engineers in Charge.—The twenty-first annual dinner of the Association of Engineers in Charge was held in the Holborn Restaurant on Saturday evening, October 8th, with Mr. W. H. Patchell, the President, in the chair. The attendance was excellent, and the mixed programme of speeches and music passed the evening very pleasantly away. The first toast was that of the United Services, which was proposed by Dr. Hele-Shaw and acknowledged by Engineer-Vice-Admiral Sir George Goodwin. Then Colonel Sankey—Captain Riall Sankey's son—called for the health of the Association. The President responded in a serious speech on labour problems, in which he pointed to the useful work that could be done by the members of the Association owing to their position. Mr. Charles Clifford Smith, a past President, gave the toast of Our Guest and Friends, and Brigadier-General Magnus Mowat, secretary of the Institution of Mechanical Engineers, responded. The health of the President was then proposed by Mr. J. E. Watkins, chairman of the Association, and was duly acknowledged by Mr. Patchell.

Explosion-proof Mining Switchgear.—A description has recently been given—see The Engineer of September 9th—of the construction of Electrical Apparatus Company's relief bolts, which, when used for the purpose of securing the cover of switchgear cases, convert the cover into a large relief valve, and protect the apparatus from damage in the event of an internal explosion, and, what is more important, prevent the ignition of inflammable gases in the mine. These relief bolts have recently been tested in various ways, but the following particulars of tests made by an independent authority are of exceptional interest. The mining regulations specify that apparatus used in fiery mines should be safe for use in an atmosphere containing methane in any explosive proportion, and in order to make these particular tests as severe as possible, it was decided the fill the box with a 9.5 per cent. methane-air mixture, which is the mixture having the maximum explosive effect, and to explode this inside the box by means of an electric spark. This was done with entirely satisfactory results. The pressure due to the explosion did not rise above 12 lb. per square inch, and did not last longer than about one-tenth second. The final test consisted of repeating the above test with an explosive atmosphere surrounding the case, in addition to the charge inside. The object of this test was to determine whether an explosion inside the switchgear case would ignite the gas outside. For the outside atmosphere, an 8 per cent. methane mixture was used, this being the most readily ignited. On exploding the charge as before, the pressure developed did not exceed 12 lb. per square inch, and its duration was less than 0.2 sec. No flame passed out at the flange, nor was the outside atmosphere ignited. There was no distortion of flanges or damage of any kind to the enclosure. The cover was held on to the box by eight relief bolts, set to allow the cover to lift $^1/_{32}$in. on explosion. The results are regarded as entirely satisfactory, and as evidence that the problem of the construction of flame-proof and explosion-proof enclosures has at last been definitely solved.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

The Reduction in Staffordshire Marked Bars.

Makers of Staffordshire marked bars were, at last week's quarterly meeting, compelled to yield to the trend of the market and reduce the price of branded bars by £2 10s. per ton, bringing it from £20 to £17 10s. This reduction became inevitable when, following long deliberation, it was decided to reduce Staffordshire unmarked bars to £14 10s. delivered, Yorkshire mills taking a similar step. Unmarked bars are a much more important Staffordshire product now than the branded bars; hence the unmarked bar people had to take their decision first. There is some demand for best iron, though the position has suffered from the rapid deterioration of other branches. The price of marked bars has remained unchanged throughout the past quarter, a reduction of £2 per ton having been made at the beginning of the period. Staffordshire and Yorkshire makers of unmarked bars are determined to put the brake on the downward rush of prices which Lancashire and some of the other districts wish to see. There is still a difference of 10s. between Staffordshire and Yorkshire prices on the one hand, and Lancashire, North-Eastern, and Scottish prices on the other. The mutual understanding which binds the Federation reserves the control of prices to each unit in its own area, so that there can be no poaching. It is no secret, however, that Lancashire mills believe the interests of the trade will be best promoted by getting down with as little delay as possible to rock-bottom prices. They are offering Crown bars for export at £14. In the Staffordshire district makers complain of unprofitable production, but are anxious to arrive as quickly as possible at a working basis, disregarding for the time being questions of profit. Iron strip remains at £17 10s. per ton. There is very little business passing; certainly not enough to maintain this article in an anomalous position. Prices of iron hoops have not been revised by the Staffordshire trade in response to the lowering of the Lancashire quotation from £20 to £17 10s. This is a branch in which there is plenty of latitude, so that individual manufacturers can take their own steps to counter outside developments. The galvanised sheet trade is a little better, works being fairly well off for orders. Prices are rather easier at £18 10s., with £14 for black sheets.

The Cabinet and Unemployment.

The iron and engineering trades here continue excited respecting the Cabinet's negotiations with the labour leaders, having for their object the relief of unemployment and, on the way, the artificial creation—if that be practicable—of a trade revival. This week's negotiations have been followed with close interest. No surprise is expressed at the refusal of labour to form a Joint Committee with the Government. The workers are regarded by the masters in the iron and engineering trades at Birmingham as still too short-sighted openly to concede that their best interests in attempting to secure employment lie along the line of full and complete harmony with capital. The cry of more productivity is nothing to them; in their case it falls upon deaf ears. Nor does the intense necessity for the creation of a greater overseas demand for the products of Midland works and workshops receive much more sympathy from them. The present trade position is full of difficulties, but it is argued in the Birmingham district this week that these might possibly be lessened if the workers were less antagonistic. The whole problem that the Cabinet and that Mr. Macnamara's Cabinet Committee upon unemployment is faced with is to find an outlet, or outlets, for the commodities which, admittedly, the workers who are unemployed at present might be turning out if they were set to work. It is, at bottom, a problem of vanishing purchasing capacity. The plain fact of the matter is that even the foreign markets which the iron and steel and engineering trades want to "recapture" can help us little until their industrial affairs also begin to return to order. In that direction improvement is likely to be slow. Mr. Lloyd George describes himself as "hopeful"; but even he can say no more than that, as far as he can see, improvement is going on. While commercial and industrial conditions in practically all the overseas markets remain distressed more or less as they are, the Government, it is feared in this part of the kingdom, even with the best intentions, will not be able to do a great deal to assist manufacturers to gain a larger share of trade.

No Sale for Pig Iron.

There is so little demand for pig iron that prices are hardly definable. Smelters would be prepared to consider lower prices if there was a prospect of securing big business, but the inquiries they are getting do not open up such a possibility. Inquiries are only for small quantities. Work at the re-started blast-furnaces of Alfred Hickman, Limited, is proceeding quietly, and there is a prospect of a further furnace being put into blast by another South Staffordshire firm this week. The quotation of 115s. for Northamptonshire foundry iron is stated to be for substantial lots only, and not to apply to orders given to enable consumers to carry on. Derbyshire forge iron has been offered at about 110s. without attracting much business. Derbyshire foundry numbers are irregular in price, but for No. 3 business could probably be done at 125s. A good deal of stress continues to be laid by smelters on the question of railway rates, in which a reduction is looked for this month. Coke prices are held rather firmly at 22s. 6d. per ton. The present position in the pig iron industry, can, it is said, only be explained by a combination of decreased consumption, continued purchasing abroad, and the using up of old stocks and scrap.

Steel.

The steel market remains dull. Purchases are only made to cover immediate requirements. British soft billets could probably be bought at £7 10s., though quotations range up to £9. The recent heavy demand has been followed by a lull, and values have weakened. For hard billets about £9 is asked. Foreign competition is absent, and Belgian merchants state that they are off the market, having nothing to offer at prices likely to be competitive in this country. Steel scrap continues rather plentiful, and can be bought as low as £2 10s. per ton.

Tinned and Lead Coated Sheets Down.

Tinned sheets have undergone a small reduction in price. At the quarterly meeting of the manufacturers, the following prices were declared:—Best charcoal to 20 gauge, 62s.; charcoal, 60s.; coke unassorted, 56s. per cwt. It was reported that there was a fair amount of business passing. Makers of lead-coated steel sheets revised their prices on the basis of 34s. to 20 gauge in 2-ton lots.

Birmingham Project Held Up.

The difficulties in the way of consummating the plans made for the establishment of an Engineers' Club in Birmingham were referred to at a luncheon on October 6th by Mr. H. R. Chattock, who took the chair in the absence of Sir Hallewell Rogers. He said the idea of the club was mooted during the war, when it was decided to form a club with a minimum membership of 500. It was further decided that it would be necessary to raise £10,000 in order to get premises and equip them. It was only possible at present to congratulate the members on a half-formed club. The condition was unfortunate, but it was one imposed upon them by the difficulties of the times. The Committee had done a lot of hard work, and the members could be got together without any difficulty. The money, however, did not come along, and as they found that in the time available they could only raise about £3000, the idea had to be given up of forming the club at the present moment. They must keep the idea alive until better times, he said. The Lord Mayor of Birmingham remarked that in view of the prominent position occupied by engineers in the city, and the large contribution made by Birmingham to the science of engineering, it was, perhaps, strange that no club had been established for engineers up to the present.

Work for Birmingham Unemployed.

The unemployment position in Birmingham is now so severe that immediate steps are being taken to alleviate some of the existing distress. An early start is to be made on the Birmingham municipal relief works. On Monday the General Purposes Committee of the City Council adopted schemes involving an expenditure of £250,000, and authorised committees to go ahead with their works in anticipation of the approval of the City Council. It is hoped by this decision to avoid further delay. The works are all to be completed by the end of the year, and will, it is believed, find employment for about 5000 men full time or 10,000 half-time workers.

Cannock Chase Miners Receive Notice.

Between 500 and 600 men working in one of the pits of the West Cannock Colliery Company, at Hednesford, have received a fortnight's notice. This development, which has created considerable concern in the district, has been entirely brought about, it is stated, by the depression in trade, and, failing a speedy improvement, there is a great possibility of the present position becoming much worse. For weeks the majority of the men on Cannock Chase have been on short time, and in some cases only two shifts a week have been worked.

LANCASHIRE.

(*From our own Correspondents.*)

Manchester, Thursday.

Iron, Steel and Metals.

The iron and steel markets of Lancashire are extremely dull just now, and the impression one gets on the Exchange is that the volume of business is still diminishing. Merchants appear to have very little to do unless they are able to negotiate import business in the low-priced finished iron and steel coming from the Continent. Makers of iron and steel are, of course, reluctant to admit that they cannot get sufficient orders, but it is impossible to hide the fact that new business comes in very slowly. The very necessary process of getting down prices is hindered by this lack of orders, for it is clear that when plants are being worked at half or a quarter pressure the incidental expenses on each ton of material turned out must be very much swollen. This is one of the main reasons why finished iron remains so dear in Lancashire. Forge pig can be had at £6, wrought scrap at £3 10s., and fuel is not so dear as it was; and yet the finished bar made from this cheap material has to be charged at £14 per ton.

Metals.

The movements in the metal markets are very insignificant at present, although there are perhaps some indications that the demand for refined copper has improved to a slight extent. This is gathered from the fact that the small differences between standard copper and electro and best select ingots have increased, more especially in the case of electrolytic copper, which has been quoted recently at over £5 above the standard quotation. The output of copper in America is still rigorously restricted, and if any considerable improvement in consumption should occur the prospects of the market would soon become much brighter. Germany is thought to have been restrained from buying of late because of the condition of the exchange; although it is, of course, very easy to put too much stress on this difficulty. Germany really buys copper by means of her export of goods, and if she has to find more marks for the former she receives more from the latter. There has been a better demand from locomotive builders, and also from the electric cable trade. What is to be feared is an attempt on the part of the American trade to rush prices up, which would probably lead to disaster. A slow and steady improvement in copper prices would make a much better foundation for higher prices later on. It will be well for consumers of copper to keep a close watch on the copper market, for in the end a very considerable advance is almost certain, and it is only a question of when it will come. The sale of an enormous quantity of Government scrap copper and brass at very low prices may afford an opportunity to buy cheap metal for a time; but steps are being taken to upset this sale by parliamentary action, and hence it is not yet certain that this large lot of metal will be placed on the market. The position in the tin market has shown very little change of late, and the prices have been remarkably steady for a long time. The general idea is that tin cannot fall very much, but that the rise is delayed by the small consumption. It is true, however, that the consumption of tin is better than it was, and improvement in this direction is continuous, if slow. There is, nevertheless, a considerable increase in the visible supply of the metal. Spelter has been quite a firm market of late, and the advance of last week has been well maintained. If Germany continues to keep off the market there is clearly a chance for higher prices caused by the growing demand from the galvanising trades. Lead has remained steady, and there is as yet no indication of collapse. Broken Hill lead will arrive next month.

Pig Iron.

There has been very little change in the pig iron market here, unless it be that the demand seems more restricted than ever. Consumers continue their policy of buying from hand to mouth, mostly in lots of 10, 20, and 30 tons, and this does not offer any inducement to makers to bring down the prices. One has the impression that if a buyer would place a fair-sized order he could obtain some concession in the matter of price; but the nominal prices here are much as they were. It may be noted that the Cleveland ironmasters have reduced the prices to 114s. on trucks for No. 4 foundry and 112s. 6d. for No. 4 forge. The former reduction may bring in a few orders for this district, for it will mean a difference of fully 6s. between No. 4 and No. 3 delivered here; but No. 4 is not very much liked in Manchester. As for the reduction in forge pig, it is quite futile so far as buyers of forge are concerned here, for it is not the price of material which restricts buying, but the fact that finished iron cannot be sold in quantities sufficient to keep the mills going. If it were not so heavy, wrought scrap would sell at much higher prices than are now current. To correspond with the present price of this scrap, forge pig iron would have to be reduced, not by 5s., but by 50s. per ton.

Finished Material.

The Staffordshire prices for bar iron have now been reduced to correspond with the Lancashire and Scotch prices; but the change comes so late that it may easily be met with another reduction in the other districts. The official prices for finished steel are much as they were so far as British makes are concerned, but the recent improvement in the continental prices seems to have come to an end. Hence the competition of foreign iron and steel is keener, and the offers now being made are more tempting. Foreign bar steel is offered, for instance, at £8 7s. 6d. delivered on c.i.f. terms, and ship plates are quoted at £8 per ton f.o.b. Our nominal price for plates is £14, but they can be bought for £12.

Scrap.

There is very little movement in the market for scrap iron and steel. Perhaps wrought iron scrap and melting steel scrap are a little better than they were; but the demand for cast or foundry scrap is weaker. Dealers here do not make much difference in the prices, although they would probably make concessions if they saw a chance of getting a good order. The state of the foundry trade is, however, such that there is no chance of consumers buying any more scrap than they want for prompt consumption, and that is not much.

Manchester Royal Exchange.

The completion of the extension of the Royal Exchange building, which was formally opened by the King last Saturday, marks the most noteworthy addition which has been made to the architecture of the city for probably half a century. The work of extension was commenced in 1914, and it was hoped that the new building would be ready by 1916, but for obvious reasons that was quite impossible. Instead of two years, seven years have elapsed since a commencement on the undertaking was made, and the proprietors are to be congratulated on the completion of their labours under circumstances which, during the war period, must have been well nigh overwhelming. To erect such a building on a virgin site would not be nearly so difficult as to adapt, add to, and take away from an existing building in the busiest centre of the city, while inflicting the minimum of inconvenience upon its occupants. The building up to the time of the latest extension covered an area of 4005 square yards, whereas the new structure covers 6755 square yards. The finished edifice is one of which Manchester folk have reason to feel proud, and much credit is due to the architects, Messrs. Bradshaw, Gass and Hope, of Bolton, who are responsible for the design. While retaining the general character of the original building, the architects have adapted the main part of the old structure to the requirements of the enlarged building. The new entrances are conveniently placed and the familiar clock tower has been retained. The great hall, which provides a rendezvous for thousands of business men daily, comprises two large bays, which are connected by an open-arched arcade the full height of the building, with arches springing from grouped columns. Besides forming an architectural feature, these columns subdivide the floor space and provide means for the location of the thousands of members, many of whom have fixed positions where they meet their friends and customers. It is claimed that the boards of the Manchester Exchange form the world's greatest place of assembly of traders for direct transactions. The membership is between 11,000 and 12,000, and every

industry for miles round is represented on these boards. All the various branches of the textile industry, engineering, iron and steel manufacture, chemical trades, collieries, rubber, wool, wood pulp, insurance, advertising, transport, shipping, have representatives whose duties take them "on the boards" almost daily to transact business. In the cotton trade alone last year there were 2000 firms represented, the combined plant of which totalled up to 60,000,000 spindles and 800,000 looms. An excellent feature of the new building which ought to be mentioned is the commercial library, the aim of which is the provision of any and every kind of commercial information which may be obtained from printed matter or from public or private sources. Under the guidance of the city's chief librarian all this information is arranged and catalogued so as to render it quickly available for inquirers.

BARROW-IN-FURNESS, Thursday.

Hematites.

The condition of affairs in the hematite pig iron trade of North Lancashire and Cumberland is gradually improving, but the process is only a slow one. There is a demand for iron and business is possible, but at lower rates than at present ruling, and lower than smelters can afford to take. There was a cut in values last week to the extent of 10s., but more than this is wanted, and in the meantime smelters on their part are faced with high costs for coal and coke and big railway rates. Wages, too, are high, and a settlement in the outstanding difference between the Furness mine owners and their men has not yet been reached. Local iron is again being consumed by Barrow steel makers.

Iron Ore.

There is only a moderate demand for hematite iron ore, and it is confined to local smelters. There are only five furnaces blowing and the consumption is of necessity limited, whilst foreign ores are being used. None of the mines of the Barrow Steel Company is working. The Roanhead Mines are fairly busy and there is activity at Pennington. At Hodbarrow and other mines in Cumberland short time is being worked. Under the sliding scale arrangement Furness miners' wages have been reduced 1s. 1d. per day to 11s. 9d. Last month the mine owners offered 11s. 8d. per day with prompt resumption of work, but this the miners declined to accept. In the meantime the price of pig iron, on which the wages are based, has declined.

Steel.

The steel trade in the Workington district has been fairly well employed for a few weeks, but at Barrow the rolling mills have been got to work only this week after being idle since last spring. The Siemens departments and the foundries are also employed and the hoop mills are busy.

Shipbuilding and Engineering.

On Thursday of last week Vickers launched at Barrow the steamer Slieve Donard. She has been built to the order of the London and North-Western Railway Company for service between Holyhead and Dublin, and is specially designed for the carrying of cattle. Deck passengers are also carried. She is 310ft. long and will have a speed of 16 knots.

SHEFFIELD.

(From our own Correspondent.)

Some Good Trade Spots.

SPEAKING a few days ago at the installation of his successor, Mr. M. Wardlow, as Master Cutler, Mr. William Clark said the steel trade of Sheffield may be under a dark cloud at the moment, but he thought there were unmistakable signs that at last the cloud was beginning to break; and that appears to be the growing conviction of manufacturers generally. Mind, there is still nothing of a very pronounced nature in the way of a trade recovery, but hardly a day passes now but one hears of individual firms striking good patches of trade. Sometimes business is secured not on a question of lowest price, but because steel of a special quality is specified. This appears to be the case in the matter of a rather important contract that I hear has just been booked for the supply of structural steel parts required in the erection of a bridge in the East. Then some big orders for tools, files and saws have been accepted from Russia, and makers of the last-named implements are said to have in hand enormous orders. I hear, too, of large quantities of special steel, as well as tool and spring steel, being consigned to a spot in Holland, though the ultimate destination of the goods is not stated. There is a fair amount of electrical machinery construction work in hand, but, taken all round, export business is extremely poor, the only redeeming feature being the requirements of the Colonies, and even they are within comparatively narrow limits. The number and variety of inquiries coming in from overseas, however, make it pretty clear that a demand exists abroad which only needs the encouragement of prices trimmed down to a more competitive level.

More Furnaces Lighted Up.

There is stated to be more activity now in magnet steel, and I have heard of some large consignments of cylinders for motor engines, suggestive of a coming revival in automobile construction. The quotation of home-produced steel has been falling for some time, and soft basic is not much above the continental level, whilst the material is decidedly superior and delivery is better, and this is having a good effect. A week ago it was estimated that about one-third of the steel furnaces of this district were in commission, but I have just heard that Steel, Peech and Tozers are lighting up a few more of their big open-hearth furnaces, and I understand that this step is to be taken as implying that there are orders on hand for which the material is needed at once. On the other hand, there are serious complaints of almost empty order books, with the result that in some cases clerical staffs are still being reduced, and junior members of drawing-office staffs are being sent into the works. A hopeful feature consists of the preparations being made in the armament departments for commencing the production of armour plates and other heavy forgings which will be required for the new battle-cruisers, and in this direction work is being found for many of the unemployed, the number of whom is steadily decreasing, though a good many thousands are still walking about with nothing to do.

The Drastic Fall in Stock Values.

Some very interesting statements were made here on Monday, at the meeting of the United Steel Companies, Limited, at which the place of the late Mr. Henry Steel, as chairman, was taken for the first time on such an occasion by his successor, Mr. Albert Peech. One was to the effect that the liquidation of some of the companies of which the United Steel combination is composed is proceeding, so that with this consolidation the latter ceases to be merely a holding concern; but it is the intention of the directors to operate the Frodingham Iron and Steel Company and the Appleby Iron and Steel Company, as well as several of the smaller concerns, as separate undertakings. But what most steel men will regard as the item of chief interest was Mr. Peech's reference to the fall in stock values. He said he wished to speak quite frankly about the matter, which, I may add, had been the subject of a certain amount of irresponsible talk for some little time. "It is," he said, "a very serious matter, and it is only fair to you and to ourselves that I should speak frankly. Those stocks were purchased in the early part of 1920, when supplies were at famine point, and at the prices then ruling. The collapse in trade found us with very heavy stocks on hand and heavy commitments. We have the right to recover from excess profits duty paid in the past a portion on the loss on these stocks, but even so it has involved the company in a very heavy loss on stocks. A company less soundly conceived than yours could not have faced such a position, but notwithstanding our heavy commitments in this regard, and short working, we were in a position to make good that loss partly out of the previous large profits we had made and partly by trenching on our reserves, and I am pleased to be able to say that all our stocks are now written down and our commitments brought to a point which relieves us from all anxiety on that score." That, I consider, was a highly important statement.

Interesting Developments.

Mr. Peech added a word which helps to reveal the trade situation. At the termination of the fourteen weeks' coal strike work was at once resumed at the company's collieries, but not at the coking plants. A resumption was also made in some of the departments at the Ickles and Stocksbridge works, but it was not until the early part of last month that work was partially resumed at Frodingham, and at the Workington Iron and Steel Company's works. At the ore mines in Cumberland a start was made only a fortnight ago—in Beckermet No. 2 mine—but the Harrington coking plant was re-started early in September. "There is no reason to be unduly pessimistic," added the chairman. "The partial re-starting is broadening gradually, and there is good ground for the opinion that the improvement will steadily continue; but it must be obvious to every thinking man that, in the present circumstances of trade, it cannot be rapid, and only a very pronounced change in the trade of this country will secure the full working of the company's undertakings." Several other points of exceptional interest were brought out by Mr. Peech, but space will only permit me to refer to two; one with reference to the new steel strip and merchant bar mills, now under erection, which will have a capacity of about 19,000 tons a month; and the other regarding the Appleby works in North Lincolnshire. There the company is carrying out a bargain made with the Government in 1917, which is involving the company in very heavy expenditure. But when finished, the plant will constitute one of the best and cheapest-working plate mills in this country, and, worked in conjunction with Frodingham, plates will be produced at a cost which must secure business if business for steel plates exists in the country. The works will have a capacity of 240,000 tons of plates a year.

Sheffield Deputation Complimented.

Mr. J. J. Broderick, H.M. Commercial Counsellor to the Embassy at Washington, was in Sheffield a few days ago, and spoke very warmly indeed of the good work done in the States recently by the deputation of four Sheffield steel men, to which reference was made in THE ENGINEER'S Seven-day Journal last week, in addition to remarks in my letter of the same issue. "This country, and Europe generally," said Mr. Broderick, "owes a great debt of gratitude to the deputation," which, he added, placed before the American authorities the British viewpoint in a manner which had maintained the dignity of our position and shown clearly to the American Legislature what the effect of the proposed increased tariff would be. The Americans, he said, liked frank statements when put in such a way as not to hurt their feelings.

U.S. Public Opinion Turned.

To put the facts very briefly, when the Sheffield steel men reached New York they were not long in discovering that no one in the States entertained the slightest doubt about the Fordney Bill becoming an Act. Even importers, exporters and financial men, who were not unaware of the embarrassing position the measure would create, saw no way of averting the difficulty and were awaiting what appeared to be the inevitable. That it was a serious situation for Sheffield was obvious. Taking high-speed steel as an example, the present tariff is £63 sterling per ton, but the new tariff would impose a duty of £200 sterling per ton, even if the valuation for duty purposes remained as at present. Owing, however, to what is known as the American Valuation Scheme, which means that duty is charged on the price at which the same or similar goods of American manufacture are being placed on the market, the duty on high-speed steel would actually range from £250 to £280 per ton, making it impossible to quote an American customer a firm price, while he, in turn, would be unable to calculate his cost of production, thus making trading quite impossible. Under these circumstances, the Sheffield deputation realised their only hope of success lay in an endeavour to influence American public opinion, and that is precisely what they set themselves to do—and what, apparently, they have accomplished. The speeches of Mr. Balfour and his colleagues made a great impression on the Senate Committee, while in the various towns visited, where meetings were addressed and interviews given, the transparent honesty of the case for Sheffield and the evidence adduced regarding the recoil on the United States likely to be brought about by the measure being placed on the Statute Book, so turned public opinion against the obnoxious clauses of the Tariff Bill, that the delegates are now able to report that the measure is held up for revision, and will not come up again until January or February next, and then, if at all, in a very modified form.

Nothing to Alarm the U.S.A.

In the meantime, the seed sown by the deputation is springing up with all the probability of a good yield, for public opinion in America is said to be steadily growing against the tariff. The official statement puts the position in this way: "The effect of this publicity was that many exporters and others who had taken no active steps to combat the tariff began active propaganda, and also communicated with their Congressmen and Senators. The delegates visited Pittsburg, Chicago, Cleveland, Detroit, New York, Boston and other centres, and did useful work in each town." They urged the fact that America is the greatest creditor nation in the world, and that with a 15 per cent. tariff she has built up a fine steel industry which manufactures 98 per cent. of her requirements. It is therefore only 2 per cent. of the total trade that Sheffield is doing at the present time—truly not very much for big America to be alarmed about.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THE position in the Cleveland pig iron trade is entirely unimproved. Business is as slack as ever, and the prospects of any immediate revival are not bright. No more furnaces are going in at present, simple because there is no demand. Indeed, some of the hematite makers are reported to have been taking iron into stock, and there is far more forge iron about than there is any market for. The little amount of No. 3 Cleveland pig iron that is being produced is readily sold at 120s., but none of the other qualities is at all freely saleable. With regard to the price of No. 4 foundry, some explanation appears to be necessary. Officially, the price is unchanged at 119s., and that is a firm makers' price, but small lots can be got from second hands at 114s. per ton. No. 1 is quoted 125s. per ton, No. 3 Cleveland G.M.B. 120s. for home consumption and 125s. for export. No. 4 forge is down to 112s. 6d. per ton f.o.b. and 125s. delivered in Scotland, whilst for mottled and white makers are open to entertain offers, though the price is nominally at 112s. 6d. and 110s. respectively.

Hematite Pig Iron.

There is little change in the East Coast hematite pig iron trade. A few sales are reported to South Wales consumers, but the demand is not brisk, and, as the output was recently increased, stocks are accumulating. Makers who were quoting 130s. per ton for mixed numbers a week ago are now prepared to accept 125s. per ton for mixed numbers, and 127s. 6d. for No. 1, both for home and export.

Iron-making Materials.

The foreign ore trade is almost lifeless. Buyers have no need to come on to the market, and are simply working on the huge stocks which they hold. Deliveries under old contracts serve to swell the imports. The freight from Bilbao is steady at 8s., with best Rubio quoted at 28s. per ton c.i.f. The coke makers generally hold out for 30s. per ton for medium blast-furnace qualities at the ovens, which is equal to about 35s. delivered at the works. In one or two instances 32s. 6d. would be accepted, and an isolated transaction at 31s. delivered is reported.

Manufactured Iron and Steel.

There is no improvement in the manufactured iron and steel trade, and orders, when they come forward, are for very small lots. All the works are operating intermittently as orders come in, and price-cutting seems to have no effect on the demand. It is believed that there will be a substantial volume of business once buyers are convinced that the bottom has been reached, but on a falling market they are not inclined to place orders. No price changes are reported this week.

The Coal Trade.

The Northern coal trade pursues a more or less dull and uninteresting course. The whole situation is very difficult. There is some uncertainty on account of the October wages question, which apparently is still in abeyance. The general expectation is that no alteration will be made in the scale which ruled for last month, which, if true, will make the colliery position worse than it was before. It will, in the first place, prevent any reduction of prices becoming possible, which in its turn will probably prevent any recovery in the coal export trade, on which the Northern coalfields so much depend. The question of price is the whole crux of the position. Merchants are in actual possession of inquiries from abroad, and are convinced that they would be followed

by much larger demands from all the West European countries and from Italy if they were in a position to quote lower figures, but collieries declare that they are at the very bottom until their costs of production can be greatly reduced. There is no improvement in the steam coal section. The demand for large coal is seriously restricted, though the call for small steams more than keeps pace with the supply, which is a direct result of the falling off in the trade for bests and screened sorts. The gas coal trade is moving only slowly, and the immediate outlook is more than usually beclouded, while for the curtailed volume of business on offer competition is correspondingly keener, with a weakening market for the poorer brands. Bunkers are very flat, and there is increasing anxiety on the part of producers to contract for next year, but so far there is nothing much being done, though very low prices have been mentioned. The coke market is dull for every kind of foundry and furnace coke, but gas coke is in brisk demand and firm in price.

Blast-Furnacemen's Wages Advanced.

A small advance is revealed in the quarterly ascertainment which governs blast-furnacemen's wages on the North-East Coast. The ascertained price of No. 3 Cleveland pig iron for July, August and September was 131s. 5.13d., an advance of 4s. 5.57d. per ton as compared with the ascertained price over the second quarter of 1921. Under the sliding scale arrangement, there is an advance in blast-furnacemen's wages of 4.5 per cent., which will raise them to 77.25 per cent. above the standard. An advance in wages at the present time will no doubt come as a surprise to many people, but it should be borne in mind that as stocks of No. 3 Cleveland pig iron stand at a very low figure, makers have apparently been able to secure for that quality of iron a higher price than was perhaps generally anticipated. In all probability the actual tonnage involved was not very great.

Shipyard Works Closed.

Because of the trade depression, Messrs. Eltringham and Co.'s shipyard and engine works at Willington-on-Tyne are temporarily closing down. It is understood that the firm will be quite ready to start again as soon as trade conditions improve.

SCOTLAND.

(*From our own Correspondent.*)

Markets Dull and Uninteresting.

TRADE in general has again been of the dullest description throughout the past week. Here and there a glimmering of hope occasionally appears, but the industrial outlook is, on the whole, discouraging in the extreme. Inquiries which are reported from time to time are evidently only meant as a test of the markets, as consumers on the whole are adhering to their stand-off policy so long as the down-grade course of prices continues.

Wages in Electrical Trade.

The Electrical Contractors' Association of Scotland and the Electrical Trades Union have agreed to a reduction of 1d. per hour from October 1st, and a further decrease in wages of 1d. per hour on November 1st. Further consideration of wages is to be subject to one month's notice by either party.

Maintaining Employment.

On the occasion of the launch of the new Anchor liner Tuscania from the Fairfield yard last week, Sir Alexander M. Kennedy, managing director of the Fairfield Shipbuilding and Engineering Company, Limited, took the opportunity to refer to the sacrifices being made at present by builders and owners in order to maintain employment. In the course of his remarks he said that there were shipbuilders to-day proceeding with work of a speculative nature in order to preserve employment to their own men, and were doing so with the certain knowledge that for every £1 expended only a return of 10s. would be received. As regards sacrifice on the owners' part the Tuscania provided a case in point. By postponing completion of this steamer the owners could have saved considerably, but in view of the slight drop in costs the Anchor Line and associated companies have authorised work on some of their vessels to proceed in the hope that further savings in oncosts will be effected. With labour accounting for about 85 per cent. of the complete cost in wages paid further co-operation on the part of the men is necessary. An improvement in certain instances had already been noted, but an all-round saving of time would be of immense value. Payment by piecework wherever possible was the best basis for everyone concerned.

Pig Iron.

The turnover in Scotch pig iron continues on a meagre scale. Home consumers are only buying on a day-to-day basis, and orders are few and of small quantity. The export turnover is merely a shadow of former transactions.

Steel and Iron.

The outlook in the steel and iron trades is very dull. Orders are becoming still fewer in number, and it appears as if the present stagnation will continue throughout the winter. The steel market is almost devoid of business of any importance, and mills are slowly but surely slackening off. There is a little inquiry for black and galvanised steel sheets, but few works have more than one or two days' rolling per week. The Eastern market shows some sign of reviving, but the financial aspect is none too certain meantime. Malleable bar iron works are still handicapped by heavy costs of coal and wages. Customers are exercising extreme caution, and makers cannot secure sufficient work to carry on at a profit. The latest reduction of £2 per ton has had very little influence, and until other two or three reductions of a similar magnitude have been made, little in the way of fresh business can be expected. Only a fair turnover is reported by wrought iron and steel tube makers.

Coal.

As in other trades, practically all branches of the Scotch coal trade are in a depressed condition. About one-third of the miners in Scotland are unemployed, and the remaining two-thirds only partly engaged, yet the output is far in excess of requirements. Ordinary industrial consumers are not in a position to purchase beyond day-to-day requirements, and those at present are almost at a minimum. House coal, too, is far below normal. Railways and gasworks, usually very good customers, are buying sparingly, and almost nothing, comparatively speaking, is being put into stock. Fifeshire and the Lothians, which depend to a large extent on the export trade, are having an exceptionally lean time. A few small steamers are in port loading for overseas destinations, but the bulk of the turnover is for coastwise dispatch. Fair bunkering orders are occasionally mentioned. Aggregate shipments for the past week amounted to 164,644 tons against 182,799 tons in the preceding week and 330,692 tons in the same week in 1913. Approximate prices show little reduction, but better terms can easily be secured for firm orders.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The Coal Trade.

THE fears that the improvement in the foreign coal export trade of a few weeks ago would not be maintained have unfortunately materialised. The demand from abroad for coals has not been sustained. Cargo coals shipped from South Wales last week were less than the figures for any of the preceding five weeks. The total was 348,000 tons, or 113,772 tons less than the previous week. As compared with the corresponding week of 1913, the total marked a decrease of just over 200,000 tons, from which it will be realised that trade is a long way from normal and employment is correspondingly less, both at the collieries and at the docks. The position all round leaves much to be desired. The experience of coal exporters is that business is fraught with the maximum amount of risk and the minimum of remuneration. The labour involved in pulling off even small orders is abnormal, and when they are obtained they give worry up to the completion of shipment. There appears to be no compensating feature in business, and for some little time to come no hope of appreciable improvement. Cutting prices, which are on rock bottom when costs of production are taken into account, achieves no material success. Buyers are not attracted, and a review of the whole situation leads to the conviction that the only practical course to remedy the existing conditions is to put right the exchange. As everyone pretty well knows, exchange rates are hitting this country hard from the point of view of commerce. Whatever the cost is of a ton of coal delivered at a French port in sterling, the French buyer has to pay double through the operation of the rates of exchange. The same principle applies in the case of Italy, Belgium, &c., and, furthermore, buyers abroad have to take the risk of the fluctuations in exchange rates. It is not infrequently the case that coal exporters here are asked to quote French buyers in francs instead of in sterling. A few firms are doing so, but the majority decline to accede for the reason that their risks are already sufficiently burdensome as regards the price of coal and the freight. The fact is that the lack of stability in the coal market is having a highly injurious effect upon business. At the moment of writing there is no news as to the decision of Sir William Plender, the independent chairman of the National Coal Board, as to what the wages costs of the owners will be for this month. All this creates uncertainty. It is conceivable that instead of coal prices coming down, coalowners may declare that they must have higher prices, which would mean less business and a further curtailment of production and employment. Such conditions in the face of the already large amount of unemployment are very depressing.

Forest of Dean Development.

There has been talk of smashing the coal agreement, and one miners' leader recently predicted that the agreement would not last three months in South Wales. From all accounts, however, the Forest of Dean looks as if it is to claim distinction for developments in this direction. It is reported that Messrs. Henry Crawshay and Co.'s group of house coal collieries have decided to break away from the national agreement terms, for the reason that they cannot sell at present prices, and that other districts are underquoting them to the extent of 10s. and 12s. per ton. It was understood that the company intended posting notices on Tuesday, 11th inst., that the pits would be open on the basis of 8s. minimum to colliers and that any profits in excess of 10 per cent. should be divided in equal proportion between the workmen and the shareholders. The miners, who met to consider the situation, decided on Monday, with one dissentient, to endorse the resolution of the Miners' Association Executive that the company's proposal could not be accepted.

Costs Other Than Wages.

An important decision has been notified to South Wales colliery companies. Recently, consultations have been taking place between the accountants of the Mining Association of Great Britain and the Miners' Federation of Great Britain on the question whether local rates payable by colliery companies in connection with miners' houses should be included in or excluded from "costs of production other than wages" in the monthly ascertainments for wage purposes. An understanding has now resulted between the parties that these rates should be included. The decision is contained in a letter from Messrs. Thomson, McLintock and Co., the accountants of the Mining Association, to Mr. W. A. Lee, the secretary of that body, in the course of which they say they are quite satisfied that, inasmuch as the gross Schedule A assessments in England and Wales are based on the rents that would be paid for the houses on the assumption that the occupiers paid their own local rates, the gross Schedule A assessments are an insufficient deduction as a cost of production to the extent of the rates paid by the owners on behalf of the workers. Accordingly, those rates are a proper item of "costs of production other than wages," in so far as they are borne by the owners and not included in the weekly sums paid by the occupiers or otherwise recovered from them. In Scotland, of course, the deduction should be restricted to the amount of occupiers' rates borne by the owner, and not included in the weekly sums paid by the occupiers or otherwise recovered from them. In neither case is property tax—income tax Schedule A—an admissible deduction.

Fall in Steel Bars.

The South Wales Siemens Steel Association has reduced the price of Welsh Siemens bars from £8 10s. to £8 5s. per ton. This decision was rather unexpected, in view of the firmness of foreign bars, but it is stated that no further fall is likely unless there is a very material change in the conditions prevailing. The desire on the part of the steel makers to assist the tin-plate trade by a reduction in the costs of production is stated to be very real, and as 90 per cent. of the tin works have their own steel works, a revival in the tin-plate trade would more than compensate for any smaller margin of profits in the steel section.

Current Business.

Current operations are on a very restricted scale. The inquiry all round is quiet, and unfortunately the amount of actual business which matures is negligible. Buyers abroad are still holding off, and whatever offers are submitted to them are countered at figures which more often than not barely cover the cost of the coal plus freight. Few, if any, collieries are working full time. By far the majority are working intermittently, owing to the difficulty of clearing standing stocks. Many collieries are not working more than two days per week. The opinion is very prevalent that no improvement will be seen in trade this year, and probably not before the spring of next year. Definite inquiries on the market are for comparatively small quantities. The Admiralty has asked for tenders for 18,000 tons of coal for use at home yards and works. These coals, principally of the house coal type, are for delivery over a period of six months from November next. Tenders have gone in for two cargoes of 5000 to 6000 tons of best steam coals or patent fuel for the Greek railways, these cargoes being for prompt shipments. The Norte Railways of Spain are reported to have purchased about 9000 tons of Crown patent fuel. Other inquiries are expected shortly, but the quantities will probably be small and for fairly prompt shipment. The general disposition is not to purchase ahead. Best Admiralty large coals are quoted at 30s., and seconds 28s. 6d. to 29s. Smalls of superior quality are relatively firmer than other descriptions, and rule about 19s. to 20s. Foundry coke is 60s. to 65s., and patent fuel 29s. to 32s. Anthracite coals are very steady, and the demand is well maintained. Sized coals are scarce, and some collieries are fully sold to the end of the year for cobbles and nuts.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Miners' Wages.

ACCORDING to a prominent miners' leader, the wages that will be paid on Friday by the coalowners, without any agreement with the miners' representatives, will be as follows:—Colliers on the minimum wage, £3 2s. 6d., being a reduction of £1 6s. 6d. per week; timbermen, £2 19s. 1½d., a reduction of £1 5s. 4½d.; hauliers, £2 13s. 5½d., a reduction of £1 5s. 5½d.; and labourers, £2 5s. 6d., a reduction of £1 5s. 3d.

Forest of Dean Miners.

Messrs. Henry Crawshay and Co. have postponed posting notices to the miners at their pits until Monday week. According to the miners' agent, the company states definitely that it will not work under the terms of the national settlement. The company has withdrawn from the District Board and from the Forest Coalowners' Association.

Swansea Metal Exchange.

There has been a little more business in tin-plates, and an increased number of mills are engaged, it being estimated that production is approximately 55 per cent. of the normal. The tin-plate market is steadier, the inquiry from abroad being more active. The galvanised sheet market is firm at £18 to £19 f.o.b. for 24 gauge corrugated. Purchases for India have been active, and a large shipment direct from Swansea has been effected recently, it being reported that others are to follow.

METR-INCH MICROMETER.—An ingenious method of permitting both British and metric readings being taken simultaneously with one micrometer is embodied in an instrument which has just been brought out by M. Veran de St. Gervais, of 2, Torrington-square, London, W.C. 1. The stem of the micrometer is engraved with divisions representing fractions of an inch in the usual manner, and has another series of divisions which follow a helical line round the stem. The helix is of such a pitch that it does not make a complete turn and consequently does not cross the inches line. There are two sets of divisions on the thimble, one of which, for reading in conjunction with the inches graduations, is normal, but is carried by a lantern-like extension of the thimble. The metric divisions, on the thimble itself, are sloped to form tangents to the helix. Confusion between the two readings is thus avoided. The instrument is, we understand, British made.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	37/-
[1] Spanish	28/-
[1] N. African	28/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	28/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—[2]		
Hematite	7 7 6	—
No. 1 Foundry	7 10 0	—
No. 3 ,,	7 5 0	—
N.E. Coast—		
Hematite Mixed Nos.	6 10 0	6 10 0
No. 1	6 12 6	6 12 6
Cleveland—		
No. 1	6 5 0	6 10 0
Silicious Iron	—	—
No. 3 G.M.B.	6 0 0	6 0 0
No. 4 Foundry	5 14 0	5 19 0
No. 4 Forge	5 12 6	5 12 6
Mottled	5 10 0	5 10 0
White	5 10 0	5 10 0
Midlands.		
Staffs.—		
All-mine (Cold Blast)	17 0 0 to 17 7 6	
Part Mine Forge	*None offering.*	
,, Foundry No. 3	*None offering.*	
Northampton *(Delivered Midlands).*—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	5 15 0 to 6 0 0	
,, Forge	5 5 0 to 5 10 0	
Derbyshire [2] *(All nominal).*—		
No. 3 Foundry	6 0 0	—
Forge	5 10 0	—
Lincolnshire—		
Basic	*Uncertain.*	
Foundry	,,	
Forge	,,	
N.W. Coast—[4]		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	7 5 0	—

MANUFACTURED IRON

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	14 0 0	—
Best ,,	17 0 0	—
N.E. Coast—		
Common Bars	14 0 0	—
Marked ,,	18 0 0	—
Tees	14 10 0	—
Lancs.—		
Crown Bars	14 0 0	—
Hoops	17 5 0	17 0 0
S. Yorks.—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Hoops	17 5 0	—
Midlands—		
Marked Bars (Staffs.)	17 10 0	—
Crown Bars	14 10 0	—
Nut and Bolt Bars	14 10 0	—
Gas Tube Strip	17 10 0	—

STEEL.

	Home.[6] £ s. d.	Export.[7] £ s. d.
Scotland—[5]		
Boiler Plates	19 0 0	—
Ship Plates ⅜in. and up	14 0 0	—
Sections	13 10 0	—
Steel Sheets ⅛in. to ⅜in.	15 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	22 0 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	14 0 0	14 0 0
Angles	13 10 0	13 10 0
Boiler Plates	19 0 0	19 0 0
Joists	13 10 0	13 10 0
Heavy Rails	12 10 0	—
Fish-plates	19 0 0	—
Channels	14 10 0	—
Hard Billets	11 0 0	—
Soft Billets	9 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	14 0 0	—
Light ,,	16 0 0 to 18 0 0	
Billets	11 5 0	—
Ship Plates	14 0 0	—
Boiler ,,	20 0 0	—
Manchester *(Prices irregular and uncertain, unchanged)*—		
[8] Bars (Round)	12 0 0 to 14 0 0	
[8] ,, (others)	13 0 0 to 15 0 0	
Hoops (Best)	17 5 0	17 0 0
,, (Soft Steel)	14 5 0	14 0 0
Plates	£12 to 14	12 0 0
,, (Lancs. Boiler)	19 0 0	
Sheffield—		
Siemens Acid Billets	16 0 0	—
Bessemer Billets	15 10 0	—
Hard Basic	11 0 0	—
Soft ,,	8 10 0 to 10 0 0	
Hoops	14 5 0	—
Soft Wire Rods	13 15 0	—
Midlands—		
Small Rolled Bars	11 10 0 to 13 0 0	
Bessemer Billets and Sheet Bars	7 10 0 to 8 10 0	
[2] Hoops	13 10 0	—
Tube Strip	11 0 0	—
Sheets (24 W.G.)	16 0 0	—
Galv. Sheets (f.o.b. L'pool)	19 0 0 to 20 0 0	
Angles and Joists	13 10 0	—
Tees	14 10 0	—
Bridge and Tank Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	21/- to 22/-
Block Tin (cash)	155 12 6
,, (three months)	158 2 6
Copper (cash)	69 7 6
,, (three months)	70 7 6
Spanish Lead (cash)	23 5 0
,, (three months)	23 0 0
Spelter (cash)	26 12 6
,, (three months)	27 0 0
Manchester—	
[9] Copper, Best Selected Ingots	71 10 0
,, Electrolytic	76 0 0
[10] ,, Strong Sheets	103 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 4½
Lead, English	24 10 0
,, Foreign	23 10 0

(Metal prices practically unchanged).

FERRO ALLOYS,

(All prices now nominal).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/6 to 1/8 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£29	12/-
,, 6 p.c. to 8 p.c. ,,	£27	12/-
,, 8 p.c. to 10 p.c. ,,	£27	12/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese	(per ton) £18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	22/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	14/6 per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS

	Export.
SCOTLAND.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	24/6
,, ,, Ell	26/6
,, ,, Splint	26/- to 30/-
,, ,, Trebles	28/-
,, ,, Doubles	26/6
,, ,, Singles	22/-
Ayrshire—	
(f.o.b. Ports)—Steam	24/6
,, ,, Splint	28/-
,, ,, Trebles	28/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	20/6 to 25/-
Screened Navigation	31/-
Trebles	27/6
Doubles	25/-
Singles	22/-
Lothians—	
(f.o.b. Leith)—Best Steam	23/-
Secondary Steam	22/-
Trebles	28/6
Doubles	26/-
Singles	22/-
ENGLAND.	
[11] N.W. Coast—	
Steams	41/-
Household	56/6 to 60/-
Coke	37/6 to 42/6
Northumberland—	
Best Steams	27/- to 27/6
Second Steams	24/- to 25/-
Steam Smalls	15/- to 17/6
Unscreened	22/6 to 27/-
Household	30/- to 35/-
Durham—	
Best Gas	27/-
Second	24/- to 26/-
Household	30/- to 35/-
Foundry Coke	40/- to 42/6
Sheffield—[12]	
S. Yorks. Best Steam Hards	32/- to 33/-
Derbyshire Hards	31/6 to 32/-
Seconds	30/6 to 31/6
Cobbles	30/6 to 31/6
Nuts	28/- to 30/-
Washed Smalls	17/- to 18/-
Best Hard Slacks	17/6 to 18/6
Seconds ,,	17/- to 17/6
Soft Nutty ,,	17/- to 17/6
Pea ,,	11/6 to 12,6
Small ,,	9/- to 10/-
House, Branch	40/- to 41/-
,, Best Silkstone	37/6 to 39/-
Blast Furnace Coke (Inland and Export)	25/- to 30/-
[13] SOUTH WALES.	
Cardiff—	
Steam Coals:	
Best Smokeless Large	30/- to 31/-
Second ,, ,,	29/- to 30/-
Best Dry Large	30/- to 31/-
Ordinary Dry Large	25/- to 27/6
Best Black Vein Large	28/- to 29/-
Western Valley ,,	27/6 to 28/6
Best Eastern Valley Large	26/- to 27/6
Ordinary ,, ,,	25/- to 26/-
Best Steam Smalls	19/- to 20/-
Ordinary ,,	10/6 to 18/-
Washed Nuts	30/- to 35/-
No. 3 Rhondda Large	30/- to 32/6
,, ,, Smalls	19/- to 21/-
No. 2 ,, Large	25/- to 26/-
,, ,, Through	20/- to 22/6
,, ,, Smalls	15/- to 16/-
Coke (export)	60/- to 65/-
Patent Fuel	29/- to 31/-
Pitwood (ex ship)	35/- to 37/6
Swansea—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	52/6 to 55/-
Red Vein	47/6 to 50/-
Big Vein	55/- to 57/6
Machine-made Cobbles	70/- to 72/6
Nuts	70/- to 72/6
Beans	57/6 to 60/-
Peas	30/- to 32/6
Breaker Duff	9/6 to 10/6
Rubbly Culm	13/6 to 14/6
Steam Coals:	
Large	29/- to 31/-
Seconds	28/- to 29/-
Smalls	12/6 to 14/-
Cargo Through	20/- to 22/6

[1] Delivered. [2] Net Makers' works. [3] At furnaces. [4] Delivered Sheffield. [5] Glasgow, Lanarkshire and Ayrshire. [6] Home Prices—All delivered Glasgow Station.
[7] Export Prices—F.O.B. Glasgow. [8] Prices represent the real market before the *official* change was made. [9] These prices are practically alike now.
[10] Sheets reduced while other prices are advancing. [11] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export.
[12] For inland sales. [13] Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

The Lyons Fair.

Judging from the first week's results of the Fair at Lyons, it may be questioned whether the holding of two fairs every year in that city is altogether justified. It is recognised that the spring gathering is by far the more important, not only in size, but also in the diversity of the industries represented, including the silk and other peculiarly French manufactures that attract visitors from adjoining countries. The autumn meeting is devoted specially to metallurgy and mechanical and electrical engineering. It occupies the space between the Rhone and the Parc de la Tête d'Or, on each side of the road bordering the site of the future palace which is now under construction. A small part of the building is finished, and is used for many of the electrical and other exhibits. Its arrangement is that of a long central hall from which branch out side galleries in three storeys, each gallery being separated from its neighbour by sufficient space to provide light to all the compartments of uniform size that are let to exhibitors. The autumn fair is held mainly in these showrooms, as well as in temporary wooden buildings that will disappear as soon as the concrete structures are completed.

Lower Prices.

The interest of the Fair lay in its offering some indication of the probable course of trade. Being in a particularly convenient centre for attracting home and foreign visitors, it was hoped that inquiries would reveal signs of the long hoped for recovery. During the first week, at any rate, visitors were rare and very little business was done, although here and there some orders were secured, notably by makers of ventilating and other machinery for the equipment of factories and mines. In steel and malleable iron castings and drop forgings some exhibitors declared that there was slight evidence of recovery, but orders were only secured by the offer of very low prices, which are coming down to their pre-war level, and makers are generally prepared to accept orders upon almost any terms for the purpose of keeping their hands employed. At the present rate of exchange, malleable iron castings are now obtainable at about 5d. per pound, which means a reduction of 30 per cent. upon the prices of three months ago. The lower prices may certainly bring in a small though steadily growing business, but there can be no general revival until the financial situation shows greater stability.

French Production.

The outstanding feature of the Fair is the growing importance of the home mechanical engineering industry as seen not only in the products of Lorraine and the Saar district, but also in the activity of many firms which have only entered this branch of industry since the war. Nearly all the leading motor car makers are engaged upon other branches of manufacture. Berliet, of Lyons, showed machine tools, and the Salmson Aviation Engine Company has gone in for the construction of woodworking machinery. There was a number of French woodworking machinery stands, but quite the best exhibits in this class were those of T. Robinson and Son, Limited, of Rochdale. On the whole, the foreign participation was not large, on account, apparently, of the difficulty of doing business in France under the present fluctuating conditions of the exchange rate, but American firms were well represented, more with an idea of keeping their productions to the fore pending a revival of trade than of securing any appreciable amount of business. It is evident that French manufacturers are now in a position to supply the greater part of the home requirements in machinery.

Electrical Engineering.

In a centre where hydro-electric installations are being actively carried out the electrical exhibits were necessarily large, and a striking feature was the importance of the plant which is required for the distribution of current under a tension of 120,000 volts. A transformer which was capable of working up to a pressure of 350,000 volts was on view. The laying down of hydro-electric plants has created a vast industry in domestic electrical appliances, for the current is to be supplied at a figure that will enable it to supersede all other forms of energy. At the same time, past experience has shown that the hydro-electric supplies are not entirely reliable, since, as the volume of water available may be reduced by severe frosts or by prolonged droughts, and as accidents to the turbines are always possible, owners of hydro-electric installations are obliged to have suction gas plants in reserve, so that the initial expense is necessarily heavy. Still, in the Lyons district, as well as in the Dauphiné, it is believed that the supply of cheap electrical energy will permit of a considerable development of local industries.

The Paris Catastrophe.

The Batignolles tunnel outside the Gare St. Lazare in Paris has always been a standing menace. The traffic of one of the busiest stations in the world passes through four unlighted tunnels, and despite precautions, it has been felt that accidents would happen at some time or another. A local train bound for Versailles, and crowded with passengers in double-deck coaches, stopped in the tunnel through a derangement of the brakes. A few minutes later another train dashed into it from behind. A gas reservoir exploded, and passengers could only escape through the smoke with great difficulty, leaving about thirty to perish in the flames, while more than double that number were injured. A signalman has been arrested pending the inquiry. The catastrophe was considerably aggravated by the system of train gas lighting, which has been suppressed on most of the other lines as the result of an order from the Minister of Public Works some years ago, when a series of accidents drew attention to the danger of gas during collision. The State railways have done nothing except make investigations, nor have they followed up the tests carried out many years ago by the old Ouest Company for lighting the tunnels.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

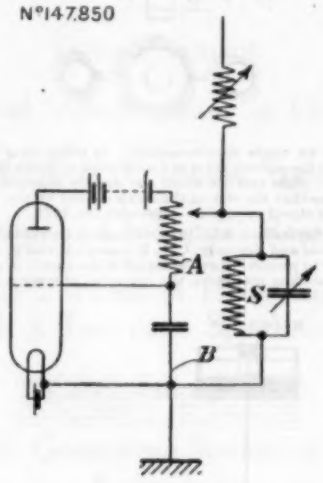
The date first given is the date of application; the second date at the end of the abridgment, is the date of the acceptance of the complete Specification.

WIRELESS TELEGRAPHY.

147,850, July 9th, 1920.—Improvements in Wireless Telegraph Transmitters, Gesellschaft fur Drahtlose Telegraphie, m.b.H., of 9, Tempelhofer Ufer, Berlin.

This invention relates to wireless telegraph transmitters in which oscillations are generated by cathode tubes, and its object is to provide means for preventing harmonics from passing to a circuit such as an antenna circuit in which they are not desired. In the drawing S is an oscillatory circuit tuned to the fundamental and connected to a cathode tube generator in parallel with the coupling A B. An infinitely high resistance is thus formed for the oscillations and therefore no energy is absorbed. There is, however, a short circuit for the resulting harmonics which cannot reach the antenna. If this circuit is calibrated to wave lengths it can at the same time serve as a wave meter.—*September 8th*, 1921.

N°147,850

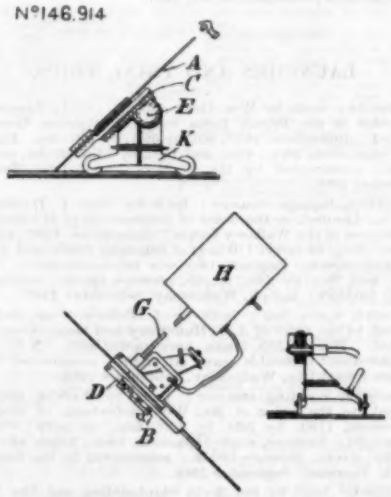


ELECTRIC WELDING.

146,914. July 6th, 1920.—Improvements in and relating to Portable Electric Welding Apparatus, Siemens-Schuckertwerke, G.m.b.H., of Siemensstadt, Berlin, Germany.

This specification describes an arrangement for automatically feeding an arc welding electrode on to the work, and the electrode is carried on a movable carriage mounted on wheels. The electrode A is secured by means of a clamping device B upon a toothed bar C, which is guided on guiding bars D and is moved by the toothed wheel E. The shaft of the toothed wheel is connected with an automatic regulating mechanism H by means of the flexible shaft G. The casing surrounding the toothed wheel and carrying the guiding bars is insulated from the frame K of the apparatus. The frame K is provided with two wheels on which the welding apparatus is carried along the edge of the metal sheet to be welded, a third wheel serving as support. The current is led to the welding electrode through the flexible conductor.—*September 8th*, 1921.

N°146,914

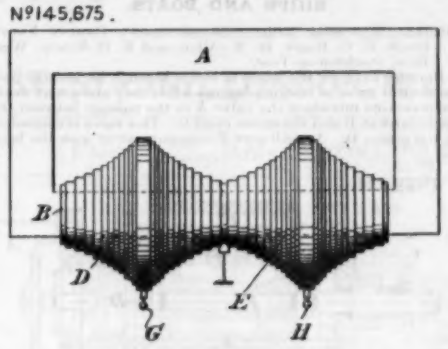


TRANSFORMERS.

145,675. June 30th, 1920.—Improvements in and relating to High-tension Electric Transformers, Siemens und Halske Aktiengesellschaft, of Siemens-str., Berlin.

A transformer constructed in accordance with this invention is shown in the accompanying drawing. A is the iron core, B a sleeve surrounding the low voltage winding and insulating it from the two high voltage windings D and E, which are placed next to one another upon the same leg of the core. The insulation B is provided as a security when the point of connection of the two high voltage windings cannot be earthed. If the point of connection of the high voltage windings D, E is not earthed, a comparatively thin insulating sleeve is sufficient, since it is subjected only to one-half the working voltage. G and H are the high voltage terminals to which the last windings are connected.—*September 8th*, 1921.

N°145,675.

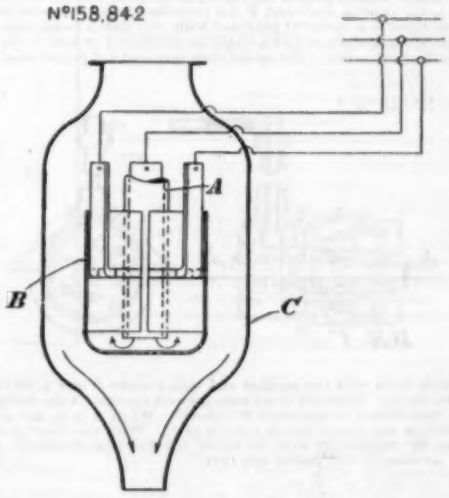


LIGHTING AND HEATING.

158,842, February 2nd, 1921.—Improvements in Electric Liquid Heaters, Festa, A-G, of 44, Stauffacherquai, Switzerland.

The electric heater described in this specification is designed to work with three-phase current. There are three electrodes in the form of sectors, arranged concentrically around a hollow insulating tube A through which the fluid to be heated flows in a downward direction. The electrodes are kept in position by an outer insulating cover B, in such a manner that three free spaces are left between the electrodes. The liquid enters the apparatus at the top, and after having passed through the central insulating tube A, it rises in the direction of the arrows through the gaps between the electrodes. When it arrives again at the top of the electrodes it can flow off freely on the outside of the shell B. The whole device is enclosed in a casing C.—*September 8th*, 1921.

N°158,842

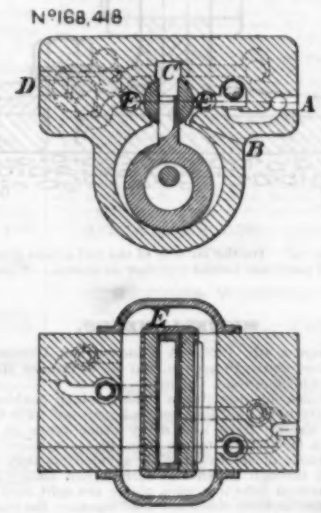


PUMPING AND BLOWING MACHINERY.

168,418. June 3rd, 1920.—Rotary Pumps, G. Handley, 76, Devonshire-road, London, N. 13, and P. W. Bullock, 7, Stone-buildings, Lincoln's Inn, London, W.C. 2.

In this rotary pump arrangements are made to maintain the suction and discharge in the same direction regardless of the direction of rotation of the pump. The suction A is branched so that it communicates with the inlet to the barrel at B and with the outlet chamber at C. Both branches have non-return valves. The outlet D is also branched to connect with C and with B, the latter by means of the loop passage E. Ball valves are arranged in these branches also. It will be seen that the valves

N°168,418



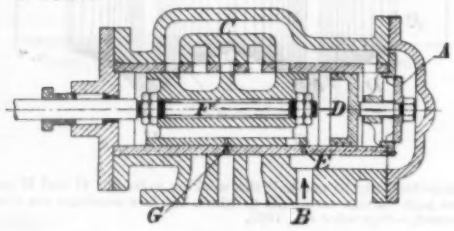
automatically open and close to accommodate the direction of rotation of the pump.—*September 5th*, 1921.

SHIPS AND BOATS.

168,532. September 28th, 1920.—Steering Engine Valve Gear, R. G. Roger, R. W. Allan, and F. O. Storey, West Row, Stockton-on-Tees.

In order to check the waste of steam through its leakage past the control valve of steering engines while they are not at work, the inventors introduce the valve A in the passage between the steam inlet at B and the steam chest C. This valve is controlled by the piston D. A small port E communicating with the back

N°168,532



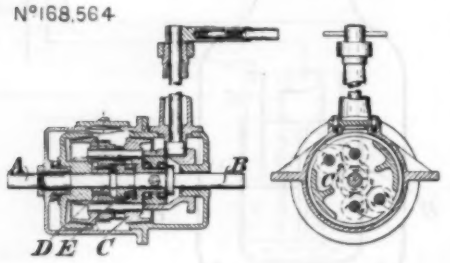
of the piston D is closed by the control valve F when the latter is in the mid position, while another port G is open to exhaust. In these circumstances the valve A is kept closed by the steam pressure. If, however, the control valve F is moved in either direction the port E is opened and that at G is closed. The steam pressure then acts on the back of the piston D and opens the valve A.—*September 8th*, 1921.

TRANSMISSION OF POWER.

168,564. March 12th, 1921.—Reversing Gear, W. Ferguson Greenbank, Johnstone, Renfrewshire.

This reversing gear is intended primarily for marine service. A is the driving shaft and B the propeller shaft. Between the two there is a spider C provided with two clutch faces, which can be engaged either with a clutch on the shaft A or with another on the fixed casing. The spider carries two sets of planet wheels

N°168,564



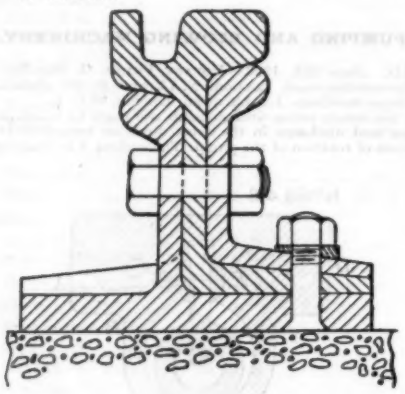
which mesh with one another and with pinions D and E on the two shafts. When the clutch engages with the shaft A the motion is transmitted to the shaft B directly. When it is in the mid position the planet wheels revolve idly. With the clutch held fast by engagement with the casing the direction of rotation of B is reversed.—*September 8th*, 1921.

TRAMWAYS AND RAILWAYS.

168,550. November 26th, 1920.—Joints for Tram Rails, G. Wardle, 5, Primrose-crescent, Fulwell, Sunderland.

In making this rail joint one side of the lower flange on the rail is cut away to permit the use of a T-shaped fish-plate on the

N°168,550



nside of the rail. On the outside of the rail a bent plate is used The several parts are bolted together as shown.—*September 8th*, 1921.

MISCELLANEOUS.

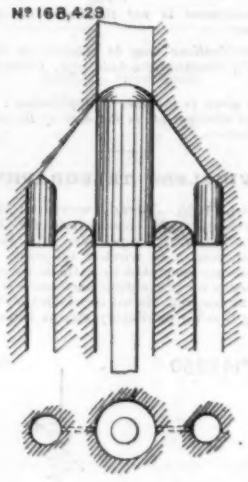
168,508, August 4th, 1920.—A Process for Utilising Mica for Electrical Purposes, Rai Sahib Sunder Mull, of 95, Lower Chitpore-road, Calcutta.

This specification describes a scheme which enables mica of a poor quality to be used for electrical purposes. For the manufacture of electric irons and many other types of electrical apparatus it is essential to use mica plates without cracks or strains. Cracks must obviously be avoided, as they present a direct path through which the current can leak. According to this invention defective mica plates are split into very fine sheets and two or more sheets are used together, the plates either being rotated relative to each other or reversed so that such defects as strains or slight cracks in one plate will not be opposite the defects in another.—*September 8th*, 1921.

168,429. June 7th, 1920.—Earth Borers, A. R. Mangnall, 43, White Friars, Chester.

This specification deals with a development of the earth borer devised by the inventor, and is intended to overcome a difficulty to which we have already referred. When it is required to bore several horizontal holes in the earth in close proximity the special form of boring head shown in the drawing is used. It is suggested that a pilot bore may be first made or, alternatively, all the

N°168,429

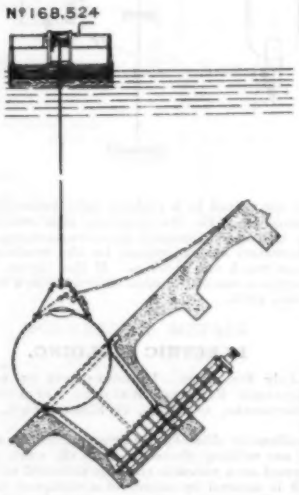


bores may be made simultaneously. In either case the heads for making the several bores are connected together by means of a thin steel plate and the heads are slightly enlarged in rear of the plate so that the slot in the earth caused by the passage of the plate is closed up again.—*September 7th*, 1921.

168,524. September 4th, 1920.—Closing Outlets in Dams, Glenfield and Kennedy, Ltd., Kilmarnock, and E. B. Ball.

In order to permit the examination of the valves in the outlets from impounding reservoirs, the inventors propose to make the

N°168,524



up-stream end of the outlet of circular form and to close it temporarily by a sphere handled from a raft. The drawing is self-explanatory.—*September 8th*, 1921.

LAUNCHES AND TRIAL TRIPS.

Nirpura: built by Wm. Gray and Co. (1918), Limited, to the order of the British India Steam Navigation Company, Limited; dimensions, 463ft. 6in. by 56ft. by 29ft. 8in. Engines, triple-expansion, 28in., 46in. and 77in. by 54in. stroke, pressure 180 lb.; constructed by the builders; trial trip, Tuesday, September 20th.

Poulton, luggage steamer; built by John I. Thornycroft and Co., Limited, to the order of Corporation of Wallasey, for the services of the Wallasey ferries; dimensions, 150ft. by 50ft. by 15ft. 6in.; to carry, 170 tons of vehicular traffic and 45 tons coal and stores. Engines, two sets triple-expansion, 14½in., 23½in. and 38in. by 24in. stroke, pressure 180 lb.; constructed by the builders; launch, Wednesday, September 21st.

Rocott, motor tug; built by J. Pollock, Sons and Co., Limited, to the order of A. J. Humphery and Henry Grey, jun., Limited. Has a 330 brake horse-power new "N E" type Bolinder direct reversible heavy oil engine, constructed by the builders; trial trip, Wednesday, September 28th.

Essonite, coasting steamer; built by Yarrow and Co., Limited, to the order of Mr. Wm. Robertson, of Glasgow; dimensions, 175ft. by 28ft. by 13ft. 6in.; to carry, 800 tons deadweight. Engines, triple-expansion, 15in., 25½in. and 41in. by 30in. stroke, pressure 180 lb.; constructed by the builders; launch, Thursday, September 29th.

Rioazul: built by the Blyth Shipbuilding and Dry Docks Company, Limited, to the order of Thompson Steam Shipping Company, Limited; dimensions, 377ft. by 53ft. 2½in. by 28ft. 9in. Engines, triple-expansion, 26in., 43in. and 73in. by 48in. stroke; constructed by North-Eastern Marine Engineering Company, Limited; trial trip, Thursday, September 29th.

Ary, steel screw steamer; built by Craig, Taylor and Co., Limited, to the order of Mr. A. C. Lensen, of Terneuzen; dimensions, 384ft. by 51ft. 4½in. by 34ft. 9in. Engines, 26in., 42in. and 70in. by 48in. stroke; constructed by Blair and Co., Limited; launch, Friday, September 30th.

City of Paris, liner; built by Swan, Hunter and Wigham Richardson, Limited, to the order of Ellerman's City Line; dimensions, 504ft. by 59ft. by 35ft.; to carry 10,500 tons deadweight. Engines, double reduction geared turbines of the impulse reaction type, pressure 225 lb. under forced draught; constructed by the builders; to carry, 230 first-class and 100 second-class passengers; left works recently.

Scalaria, oil tank ship; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Anglo-Saxon Petroleum Company, Limited; dimensions, 427ft. by 53ft. 4in. by 31ft.; to carry, 8500 tons deadweight. Engines, triple-expansion; constructed by Wallsend Slipway and Engineering Company; trial trip recently.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Junior Institution of Engineers.—Caxton Hall, Westminster, S.W. 1. Paper, "Electric Cranes," by Mr. C. H. Woodfield. 8 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Lecture Theatre of the Mining Institute, Neville-street, Newcastle-on-Tyne. Presidential address by Sir Wm. Joseph Noble, Bart. 6.30 p.m.

Electro-Harmonic Society.—The Great Hall, Cannon-street Hotel. First smoking concert. 8 p.m.

MONDAY, OCTOBER 17th.

Institute of Transport.—Institution of Civil Engineers, Great George-street, S.W. 1. Presidential address by Sir Henry P. Maybury. 5.30 p.m.

Bradford Engineering Society.—Lecture Hall, Bradford Technical College. "The Heat Treatment of Tool Steels," by Mr. S. N. Brayshaw. 7.30 p.m.

TUESDAY, OCTOBER 18th.

Institution of Engineers and Shipbuilders in Scotland.—Rankine Hall, 39, Elmbank-crescent, Glasgow. Presidential address. 7.30 p.m.

Institution of Automobile Engineers.—Chamber of Commerce, New-street, Birmingham. Paper, "The Development of the Single-cylinder Solo Motor Cycle," by Mr. H. D. Teuge. 7 p.m.

WEDNESDAY, OCTOBER 19th.

Thornycroft Engineering Society.—J. I. Thornycroft and Co., Limited, Works Canteen, Basingstoke. "Comparative Motor Cycle Performances," by Mr. D. S. Heather. 7 p.m.

Societe des Ingenieurs Civils de France.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Paper, "Tanks and Chain-track Artillery," by Mr. L. A. Legros. Films. 8 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Lecture Theatre, Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Lecture, "The Position of Aviation To-day," by Major-General Sir Sefton Brancker. 7.30 p.m.

Society of Glass Technology.—Mappin Hall, Applied Science Department, The University, Sheffield. Papers:—(*a*) "The Properties of the Lime-Magnesia (Dolomitic Lime) Glasses and their Commercial Application," by Miss Violet Dimbleby, Mr. F. W. Hodkin, and Dr. W. E. S. Turner; (*b*) "Note on the Composition, or the Comparative Composition, of Glass House Pots in Olden Times," by Mr. G. V. Evers. 2.45 p.m.

The Industrial League and Council.—Caxton Hall, S.W. 1.—Lecture, "Economic Axioms of Industry," by Mr. E. W. Pelter. 7.30 p.m.

Institution of Automobile Engineers.—Special session at Olympia, in the Grill Room, when the following papers will be read and discussed:—11 a.m., "The Scope of the Motor Tractor Industry and some Notes on Tractor Design," by Mr. E. H. Arnott; 2.30 p.m., "The Agrimotor—Present Failings and Future Prospects," by Messrs. H. Scott Hall and H. G. Burford.

Institution of Automobile Engineers: Birmingham Graduates' Section.—At Chamber of Commerce (Room 5), New-street, Birmingham. 7.30 p.m.

THURSDAY, OCTOBER 20th.

Institution of Automobile Engineers.—Special session at Olympia, in the Grill Room, when the following papers will be read and discussed:—11 a.m., "Coke as a Fuel for Commercial Vehicles," by Mr. T. Clarkson; 2.30 p.m., "Loading Devices for Commercial Vehicles," by Mr. W. D. Williamson.

Institution of Automobile Engineers.—Meeting of the London Graduates at 28, Victoria-street, S.W. 1. Paper, "Motor Cycles," by Mr. L. H. Rochford. 7.30 p.m.

Manchester Association of Engineers: Students' Section.—Chemical Lecture Theatre at Municipal College of Technology, Sackville-street, Manchester. Lecture, "Electricity," by Mr. Julius Frith. 7 p.m.

FRIDAY, OCTOBER 21st.

Institute of Transport.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Lecture for graduates and students, "Water Transport—Coastwise Shipping of the United Kingdom," by Mr. M. Salt. 5 p.m.

Junior Institution of Engineers.—Caxton Hall, Westminster, S.W. 1. Lecturette, "Pyrometry for Boilers: Some Questions, Pertinent and Impertinent," by Mr. C. E. Foster. 8 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James' Park, S.W. 1. General meeting. Eleventh report to the Alloys Research Committee: "On Some Alloys of Aluminium," by Dr. Walter Rosenhain, Mr. Sydney L. Archbutt, and Dr. D. Hanson. 6 p.m.

Institute of Metals: Sheffield Local Section.—Mappin Hall, University of Sheffield. Sorby Lecture on "The Services of Dr. Sorby to Metallurgy," by Professor C. H. Desch. 7.30 p.m.

MONDAY, OCTOBER 24th.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, S.W. 1. Paper, "The Efficient Utilisation of Steam and Electric Power in Factories," by Mr. R. E. Light. 7 p.m.

Institution of Automobile Engineers.—Meeting of Loughborough Graduates in Room 119, The College, Loughborough. 7 p.m.

TUESDAY, OCTOBER 25th.

Women's Engineering Society.—Club Room, 26, George-street, Hanover-square, W. Lecture, "Stainless Steel," by Miss C. Griff. 6.15 p.m.

Institute of Marine Engineers.—The Minories, Tower-hill, E. "Modern American Methods in Winning and Preparing Coal," by Mr. J. H. Anderson. Lantern. Ladies invited. 6.30 p.m.

WEDNESDAY, OCTOBER 26th.

Institution of Automobile Engineers.—Royal Automobile Club, Pall Mall, S.W. 1. Annual dinner. 7.30 p.m.

FRIDAY, OCTOBER 28th.

Institution of Mechanical Engineers.—Storey's-gate, S.W. 1. Discussion on the Eleventh Alloys Report to be resumed. 6 p.m.

Junior Institution of Engineers.—Caxton Hall, Westminster, S.W. 1. Lecturette, "Water-gas Manufacture," by Mr. F. Colin Sutton. 8 p.m.